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6 PRODUCT IMPROVEMENT TEST

OF

RADIO TERMINAL SETS AN/TRC-117/151 AND AN/TRC-145

9 FINAL REPORT

BY

10 CPT PAUL T. PASHIA  
MAY 1977



11 May 77

12 82p.

13 Apr. 77

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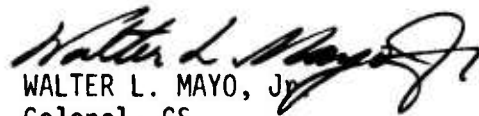
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Sets AN/TRC-117/151 and AN/TRC-145, TECOM Project No. 6-EE-  
TRC-117-005

Project Manager  
U. S. Army Tactical Communications Systems  
Fort Monmouth, NJ 07703

1. Subject TECOM Evaluation has been prepared by this headquarters and is provided for decision review.
2. Applicable TECOM test reports are appended to the evaluation letter.

FOR THE COMMANDER:

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as

  
WALTER L. MAYO, Jr.  
Colonel, GS  
Deputy to the CG for Testing



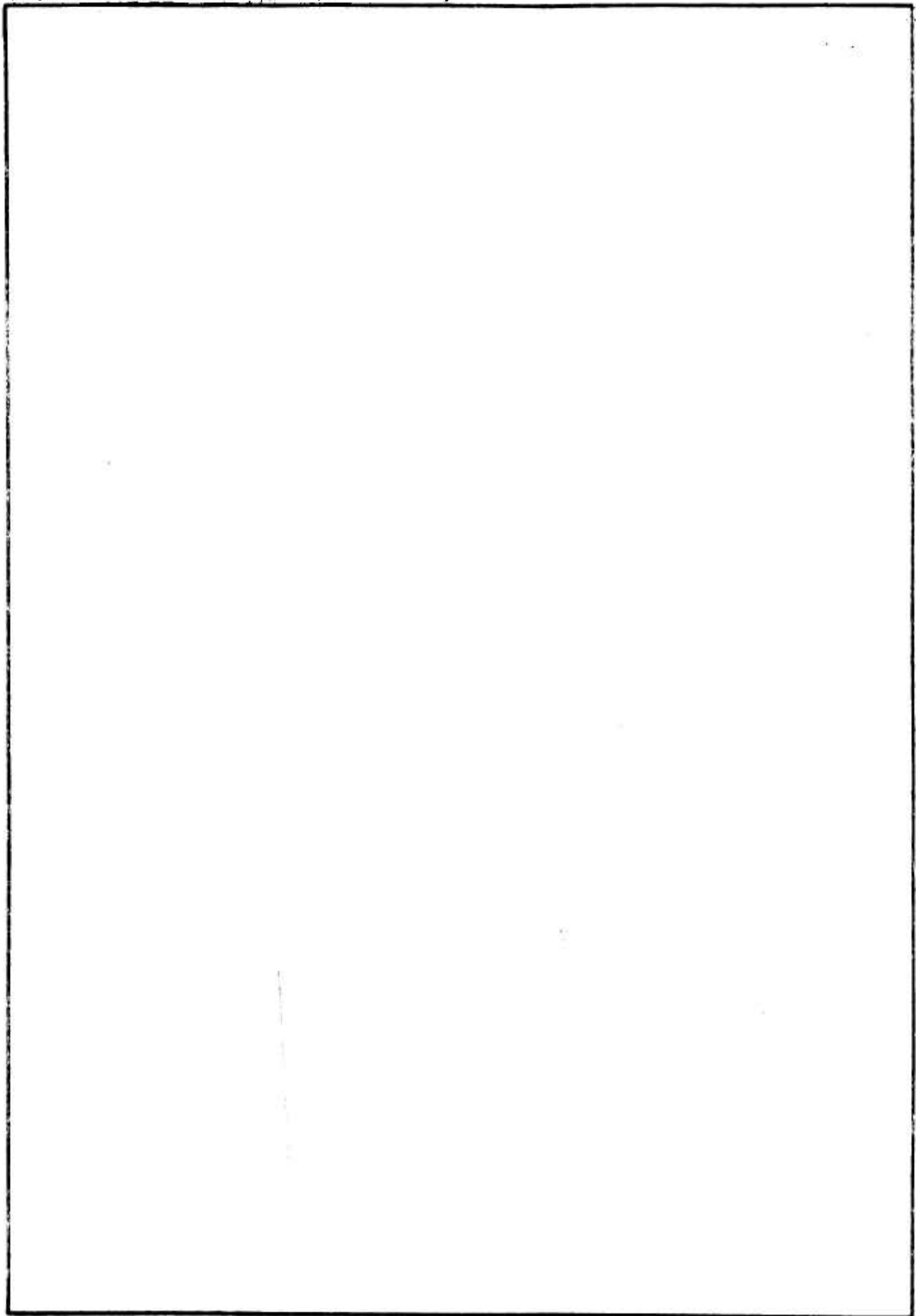
TECOM EVALUATION  
PRODUCT IMPROVEMENT PROGRAM  
OF  
RADIO TERMINALS AN/TRC-117/151 AND AN/TRC-145

11 APRIL 1977

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This document is a TECOM evaluation of the Product Improvement Program for Radio Terminals AN/TRC-117/151 and AN/TRC-145. The report presents the results of PIP testing and states that installation of the TD-1065 (HSSDB) and TD-1069 (TDDM) does not degrade operation of the radio terminals. <i>A</i>		



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TECOM EVALUATION  
PRODUCT IMPROVEMENT PROGRAM  
OF  
RADIO TERMINAL AN/TRC-117/151 AND AN/TRC-145

I. INTRODUCTION.

A. PURPOSE. This document contains an engineering technical assessment summary of test results contained in Product Improvement Test (Appendix D, attached) of Radio Terminal Sets AN/TRC-117/151 and AN/TRC-145. Since this project started prior to implementation of the Single Integrated Development Test Cycle (SIDTC), an Independent Evaluation Plan (IEP) and Test Design Plan (TDP) were not prepared; accordingly, this evaluation was not coordinated with any other DARCOM command or agency.

B. BACKGROUND AND SCOPE.

1. Current Department of Army planning calls for existing telephone and radio terminal shelter assemblages to be modified to pass high speed digital data, by the installation of the High Speed Serial Data Buffer (HSSDB, TD-1065/G) and the Time Division Digital Multiplexer (TDDM, TD-1069/G). Modification of these assemblages is in conformance with the Materiel Need (MN) documents of the TD-1065/G and TD-1069/G, which require that these items be installed in data terminal sites and in communications centers of the Army Tactical Communications Systems (ATACS).

2. Tobyhanna Army Depot (TOAD) performed the product improvement modification of Radio Terminal Sets AN/TRC-117/151 and AN/TRC-145 (reference 5, Appendix A). The AN/TRC-151 is identical to the AN/TRC-117, except for different multiplexers, thus only one assemblage (AN/TRC-117 Test Item) was modified for product improvement testing. (NOTE: The AN/TRC-151 Radio Terminal is identical to the AN/TRC-117 Radio Terminal except that Multiplexers TD-660/G and TD-754/G replace the TD-352/U and TD-204 Multiplexers which are used in the AN/TRC-117.)

3. The modification consists of the installation of two TD-1065 (HSSDB) and two TD-1069 (TDDM) in both radio terminals, to include all brackets, shelves and cabling for the interface of the TD-1065's and TD-1069's to provide for transmission of the high speed digital data.

4. Personnel from USAEPG witnessed water tightness (rain), fording, center of gravity/lateral stability, weight distribution, immersion, drop, vehicular and railroad transportation subtests at TOAD. Other testing was conducted at USAEPG from Feb through Sep 76. All testing was in accordance with the approved test plan (Item 2, Appendix A).

5. Radio terminals AN/TRC-117 and AN/TRC-145 are air or vehicular transportable assemblages. The AN/TRC-117 provides 24 channel pulse code modulated (PCM) communications and the AN/TRC-145 provides dual 12 channel PCM communications. The terminals are located in the Army Corps and Division command systems. Both assemblages house identical equipment except that the AN/TRC-117 contains a 24 channel radio combiner (TD-202/U) to multiplex 12 or 24 channels. All components of the AN/TRC-117 are rack mounted in an S-280, 2-1/2 ton shelter and components of the AN/TRC-145 are rack mounted in a 1-1/4 ton shelter.

6. One AN/TRC-117 and one AN/TRC-145 were provided as test items. Testing was combined with the Product Improvement Program (PIP) testing of Telephone Terminal assemblages AN/TCC-61, 65, 69, 72 and 73 to save time and reduce support requirements. Soldier operator/maintainer personnel were operators and data collectors throughout the tests.

## II. ENGINEERING ASSESSMENT.

A. SAFETY. The draft final report (Appendix C) identifies a safety deficiency on both the AN/TRC-117 and AN/TRC-145 assemblages. This deficiency pertains to the inability of operating personnel to open the emergency exit in the required three seconds (MIL-STD-1742B, para 5.13.4.2). An average of 25 seconds was needed by two persons to open the emergency exit. This problem was identified in a previous test (DT III of the AN/TSQ-84) as a problem inherent to S-280 shelters and the developer is aware of the problem. This deficiency is not considered to be part of the product improvement portion of this test.

B. No written procedures or special test equipments are provided to operators or technical controllers to aid in establishing circuits of digital transmission quality. Analog procedures and test equipment which are available in the shelters do not evaluate digital transmission. Thus, the only evaluation available to the operator is . . . if the circuit will pass digital traffic, it works . . . and digital circuit quality remains unknown.

C. During the initial phase of testing (Phase I) satisfactory digital transmission could not be achieved, i.e., loss of synchronization (drop-outs) occurred which resulted in high error rates in data transmissions. Causes could not be identified. Criteria for this subtest requires that the system operate error free for a 24-hour period (MIL-STD-188-100). Later, during a joint ECOM/USAEPPG investigation (Phase II) several sources of errors were observed and the causes identified:

1. Errors occurred during electrical storms.
2. Errors occurred when switching power sources while transmitting data.

3. An intermittently defective TD-754 multiplexer was found at a relay site (this multiplexer had been used during two of the tests during Phase I).

4. Ringing the order wire (OW) circuit sometimes caused errors. System performance during Phase II was significantly improved over Phase I. Two drop-outs\* occurred during the period of test in Phase II, whereas 96 drop-outs occurred during a similar period in Phase I. (\*Drop-out is defined as a loss of system synchronization resulting in a loss of Bit Count Integrity (BCI).)

D. Data were collected using an integrated cable/multi-channel radio system in accordance with the approved plan of test (reference Appendix A.2). All testing was performed in conjunction with DT II testing of the TD-1065 High Speed Serial Data Buffer (HSSDB) and TD-1069 Time Division Digital Multiplexer (TDDM).

E. No issues were formally identified as critical issues during the conduct of the testing program.

F. Except for the safety deficiency discussed in II.A. above, the assemblages are considered safe to operate and maintain.

G. This Product Improvement Program (PIP) provides the additional capability for the AN/TRC-117 and AN/TRC-145 Radio Terminals to pass 16 or 32 kilobits per second (Kbps) digital data over the ATACS system. (Present capability is 2400 bits per second.)

H. Deficiencies. Four deficiencies were identified during this PIP, and they are listed below:

1. Both assemblages failed to meet the requirement to open emergency exits in the required three seconds. This deficiency is discussed in paragraph II.A. NOTE: Although this is not considered a part of this PIP, it is considered a deficiency of the shelter.

2. Operational performance was impaired during transmission of high speed digital data due to a lack of system/technical control procedures and test equipment not presently included in the system configuration.

3. Both assemblages sustained permanent damage during the rail transportation subtest. Damage consisted of broken bolts in mounting racks, racks loosened from walls and washers on bolts pulling through holes in mounting bars.

4. DEP TM 11-5895-366-14-1 and DEP TM 11-5895-453-14-1 are incomplete. Manuals do not include cable interconnect instructions or organizational troubleshooting procedures for the TD-1065 and TD-1069. Repair parts and Special Tools List (RPSTL) is missing and block diagrams do not incorporate the TD-1065 and TD-1069 as part of the system. This prevents operators from performing required functions.

I. Shortcomings. Shortcomings were identified during this PIP in the areas of safety, weight distribution and human factors as follows:

1. The AN/TRC-117 has an obstruction presented by the storage compartment for the antenna, sharp corners on the weapons rack, and incorrect color coding on the warning labels on the video and antenna entrance panels (label should be red instead of black). Reference MIL-STD-454C and MIL-STD-1472A.

2. The AN/TRC-145 does not have lift caution labels which constitutes a marginal personnel hazard. Further, the color coding of warning labels is incorrect (label should be red). This constitutes a marginal safety hazard to personnel.

3. Both assemblages exceed the 5% unbalance limitation for the weight distribution test (reference SCL-1280D, para 3.4.2.2.2).

4. Noise levels in both assemblages are of a magnitude which impairs oral communication (reference MIL-STD-1474(MI), Category F, para 5.1.1).

5. HFE design of the AN/TRC-145 is not adequate as evidenced by the following (reference MIL-STD-1472B):

a. Coats hanging on the coat rack block operation of the air conditioner.

b. Use of old type connectors in lieu of the newer connectors (see photo, page 2-29, Appendix C of this report) requires more space and time to accomplish patching.

c. The shelter door locking device is unsatisfactory because the pin used to hold the door open usually became wedged at an angle and was difficult to remove when closing the shelter door (shelter shortcoming).

d. Latch on the door vent cover does not hold the air vent open on windy days. Operator must frequently reposition the door air vent.

e. Color coding on indicator lights is incorrect, i.e., red for "power on." Normally red instead of green warns the operator of a "malfunction" or "no-go" condition (reference MIL-STD-1472B).

J. RAM Summary. Since there were no chargeable failures as a result of the installation/operation of the TD-1065 HSSDB and TD-1069 TDDM during the PIP tests, there was no degradation to the reliability of the modified AN/TRC-117 and AN/TRC-145 radio terminals. The AN/TRC-117 operated a total of 686 hours and the AN/TRC-145 operated for 691 hours. Maintenance actions required for the TD-1065 and TD-1069 did not adversely affect the maintenance burden of the shelter assemblages. DEP TM 11-5895-366-14-1 and DEP TM 11-5895-483-14-1 are not adequate in that some procedures are incomplete and do not enable operators to perform necessary functions (see para II.H.4). (SOMTE comments are found in Appendix E of Appendix D to this report).

III. NEW ISSUES IDENTIFIED. None

IV. COMMENT: The common safety deficiency found in the PIP (S-280 and S-250 shelters) is the inability of personnel inside the shelters to open the emergency exit in three seconds or less. This safety requirement can be found in MIL-STD-1472B, para 5.13.4.2. It should be noted that this deficiency is a shelter problem and not a part of the PIP portion of the system. This deficiency has been previously identified as a shelter problem (DT III of the AN/TSQ-84) and should be addressed separately by the developer. This deficiency should not impede the PIP covered by these tests.

V. CONCLUSIONS:

A. There is no degradation in overall operation of the AN/TRC-117 and AN/TRC-145 assemblages as a result of the installation of the TD-1065 HSSDB and the TD-1069 TDDM.

B. When systems/technical control procedures and test equipment for evaluating digital circuit quality are provided, the AN/TRC-117 and AN/TRC-145 will have the increased capability of passing high speed digital data over the ATACS system as specified in requirements documents.

C. The test items are safe to operate and maintain, except that the inability of operator personnel to open emergency exits in the required three seconds does not meet current requirements.

D. TM's do not address specifically the operation/maintenance of the TD-1065 HSSDB and the TD-1069 TDDM when the units are installed in the PIP assemblages.

VI. RECOMMENDATIONS:

A. That the deficiencies and as many shortcomings as feasible be corrected and that corrections be demonstrated prior to fielding of the equipment.

B. That the developer validate the three second requirement and investigate all exit requirements concerning his systems with subsequent modification(s) where appropriate.

VI. APPENDICES.

A. References

B. Human Factors

C. USAEPG final Draft of Product Improvement Test of Radio Terminals AN/TRC-117/151 and AN/TRC-145, TECOM Project No. 6-EE-TRC-117-005, Publication No. USAEPG-FR-922.

## APPENDIX A

REFERENCES

1. Letter, AMSTE-EL, HQ, TECOM, 25 Jan 74, subj: Test Directive for Product Improvement Test of Radio Terminal Set, AN/TRC-117/151, TECOM Project No. 6-EE-TRC-117-005.
2. Plan of Test, Product Improvement Test of Radio Terminal Set AN/TRC-117/151, TECOM Project No. 6-EE-TRC-117-005, Publication No. USAEPG-TP-922, May 1975.
3. Letter, AMSTE-EL, HQ, TECOM, 7 Feb 74, subj: Test Directive for Product Improvement Test of Radio Terminal Set AN/TRC-145, TECOM Project No. 6-EE-TRC-145-003.
4. Letter, AMCPM-ATC-TR-9, ATACS, 26 Nov 73, subj: Product Improvement on the Integration of the TD-1065/1069 into Low and Medium Capacity Assemblages.
5. SCL-1280D, Design of Electronic Equipment and System Installations in Shelters and Vans, 15 Mar 65.
6. Letter, AMSTE-EL, TECOM, 8 Aug 75, subj: PIP Tests; Radio Terminal AN/TRC-145, TECOM Project No. 6-EE-TRC-145-003, and Telephone Terminal AN/TCC-65, TECOM Project No. 6-EE-TCC-065-009.

APPENDIX BHUMAN FACTORS

In general, human factors design for the operator is adequate. However, human factors problems associated with noise levels, poor design and misuse of color coding, warrant changes discussed below.

a. AN/TRC-117/151.

(1) The noise level is of a magnitude which will greatly impair verbal communications. Noise level exceeds the upper limit for frequent telephone and direct communication at distances up to five feet.

(2) The requirement for the operator to frequently reposition the door vent cover on windy days will reduce time needed for productive tasks and should be corrected.

b. AN/TRC-145(V).

(1) See comment (1) for AN/TRC-117/151.

(2) Coat rack should be relocated to prevent blocking of air circulation.

(3) Patch panel should make use of the newer type connector in order to save both space and time.

(4) The pin which holds the door open usually wedges at an angle and is difficult to remove. A more simple and effective locking device should be used.

(5) Misuse of color coding results in inefficient operation and possible mistakes and should be corrected.

(6) The shelter ceiling does not allow troops over 5 feet 5 inches to stand erect.

## SUMMARY OF RESULTS

1. The range of signal input requirements at the TD-1065 appears to be an extremely narrow limit. These input requirements should be evaluated to determine that signals arriving from distant equipment have a satisfactory likelihood of falling within the range under typical field conditions. There is no evidence of analog performance changes due to product improvement modifications.
2. The test items were safe to operate and maintain with one exception. The emergency exit could not be opened within the specified 3 seconds. (Deficiency)
3. The specification for the physical movement tests were met with the exception of the railroad transportation test. Permanent damage to mounting structures resulted. (Deficiency)
4. Publications were incomplete with regard to scope and instruction. (Deficiency)
5. Other problems were noted in the areas of weight distribution and human factors engineering. (Shortcomings)

## FOREWORD

The U.S. Army Electronic Proving Ground (USAEPG), Fort Huachuca, Arizona, was responsible for test planning, execution, and reporting.

Of the many personnel within USAEPG who helped the author in discharging this responsibility, special recognition is given Lewis Bruce, Joe Kintner, and Dave Spahr for their assistance in providing technical expertise as needed.

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## SECTION 1. INTRODUCTION

### 1.1 BACKGROUND

a. Existing Telephone and Radio Terminal Shelter Assemblages were modified to provide for the integration of the High Speed Serial Data Buffer (HSSDB TD-1065/G) and the Time Division Digital Multiplexer (TDDM TD-1069/G). The modifications of the assemblages are in conformance with the respective Materiel Need (MN) documents for the TD-1065/G and TD-1069/G, which require that these items be located in data terminal sites and communication centers in the Army Tactical Communications Systems (ATACS).

b. Tobyhanna Army Depot (TOAD) was tasked to perform the improvement modification of the Radio Terminal Sets AN/TRC-117/151 and AN/TRC-145. The AN/TRC-151 is identical to the AN/TRC-117, except for some solid state components, thus, only one assemblage (AN/TRC-117) (the test item) is being modified for product improvement testing.

### 1.2 DESCRIPTION OF MATERIEL

a. The Radio Terminal Sets AN/TRC-117/151 and AN/TRC-145 (figs. 1 and 2) are air or vehicular transportable assemblages used to provide 24-channel and dual 12-channel pulse code modulation (PCM) communications respectively. They are used in the Army, corps, and division command systems. Both assemblages house identical equipment except that the AN/TRC-117/151 also contains a 24-channel radio combiner. All components of the AN/TRC-117/151 are rack mounted in an S-280 2-1/2 ton shelter whereas the components of the AN/TRC 145 are rack mounted in a 1-1/4 ton shelter.

b. The product improvements of the AN/TRC-117/151 and AN/TRC-145 consist of modifications to the shelter facility portion of the assemblage to include all brackets/shelves/racks/mountings and electrical cable changes necessary to interface with HSSDB and TDDM units. The modifications will provide for the installation of two each TD-1065/G and two each TD-1069/G.

### 1.3 TEST OBJECTIVES

The objectives were:

a. To determine to what degree the product improvement (PI) modifications, as applied to the AN/TRC-117 and AN/TRC-145, provide the required interface with the TD-1065/G and TD-1069/G.

b. To determine the assemblage degradation (if any) due to the PI modification.

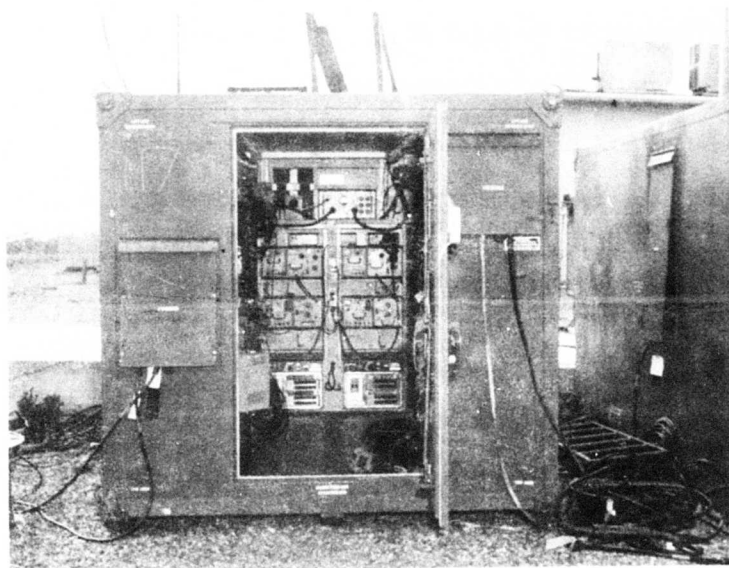


Figure 1. Radio Terminal Set AN/TRC-117/151.

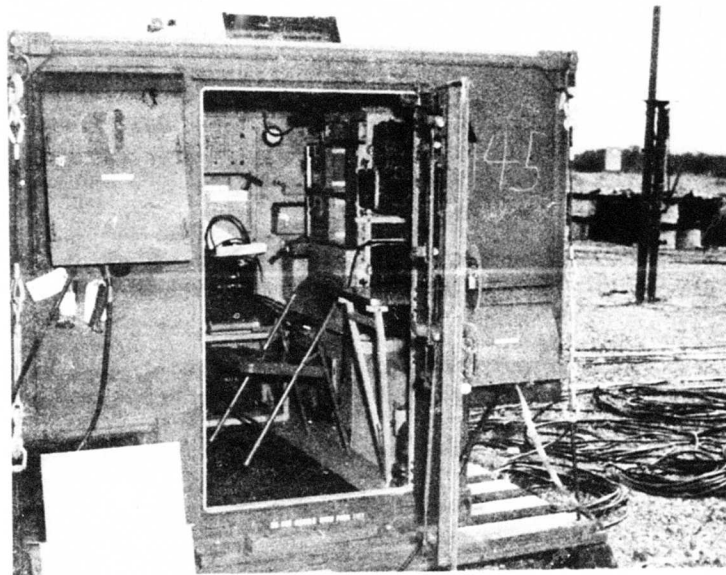


Figure 2. Radio Terminal Set AN/TRC-145.

#### 1.4 SCOPE

a. Personnel from the US Army Electronic Proving Ground (USAEPG), Fort Huachuca, Arizona witnessed the Watertightness (Rain), Fording, Center of Gravity/Lateral Stability, Weight Distribution, Immersion, Drop, Vehicular Transportation, and Railroad Transportation subtests at TOAD during the period November 1975 to January 1976. Other testing was performed by USAEPG during the period February 1976 to September 1976.

b. One each test item AN/TRC-117 and AN/TRC-145 was provided for testing.

c. Reliability testing was not performed; however, accumulated operating hours and chargeable failures were reported.

d. A complete maintenance evaluation was not performed; however, the adequacy of the updated technical manual was verified and a detailed record of actual maintenance performed was reported in accordance with TECOM Supplement 1 to AR 750-1.

e. Criteria for testing was taken from the equipment specifications MIL-S-55557A(EL), MIL-S-55590C(EL), MIL-S-49038(EL), SCL-1208D, EL-CP0131-001A, MN for TD-1065, EL-CP0138-0001A, MN for TD-1069, and the approved test plan. Other criteria for safety and human engineering was derived from applicable military specifications and standards.

f. Testing of the AN/TRC-117 and AN/TRC-145 was coordinated with the product improvement testing of other modified assemblages (AN/TCC-61, AN/TCC-69, AN/TCC-72, AN/TCC-73(V)2, and AN/TCC-65 so as to minimize the need for additional support.

g. Soldier operator/maintainer personnel were operators and data collectors throughout the tests. (See app E for comments.)

h. An environmental impact statement has not been received from the developer.

## SECTION 2. DETAILS OF TEST

### 2.1 SAFETY

#### 2.1.1 Objective

The objective was to determine if the test item is safe to operate and maintain.

#### 2.1.2 Criterion

The test item shall meet the pertinent safety requirements of MIL-STD-454C, MIL-STD-1472A, and SCL-1280D.

#### 2.1.3 Data Acquisition Procedure

- a. A safety officer and the test officer conducted a safety survey of the test item.
- b. A continuous safety surveillance was maintained by test personnel throughout testing to detect and define material design, handling, or other factors that might present safety hazards to personnel and equipment.
- c. Test personnel recorded unsafe conditions noted during the test.
- d. Testing did not commence until the receipt of a safety statement.
- e. MIL-STD-882 was used as a guide to classify hazard levels.
- f. SOMTE comments were solicited.

#### 2.1.4 Results

During the test the unsafe conditions listed below (and in appendix E), were noted on the equipments.

##### a. AN/TRC-117/151

(1) The storage component for one of the parabolas located on the floor in front of the folding desk obstructs the movement of operator/maintainer personnel during the removal of the TD-1069.

(2) The weapons rack base has sharp corners.

(3) The DANGER HIGH VOLTAGE label on the video and antenna entrance panel has a black background with light lettering.

(4) An average of 25 seconds was needed by 2 persons to open the emergency exit. Four each hand knobs and a louvre had to be removed prior to opening of the emergency exit. Also the frame of the louvre has an angle that can entrap the thumb when removing the top hand knobs.

b. AN/TRC-145

(1) There are no lifting caution labels affixed on the CV-1548 telephone converters and AN/GRC-103 radio.

(2) The power input "Warning 115 VAC Only" label has a black background with light lettering. The label does not include phase and frequency characteristics.

(3) There is no exit labeled EMERGENCY EXIT. The time to open the smaller door mounted on the main entrance door was 25 seconds.

2.1.5 Analysis

a. AN/TRC-117/151

(1) The obstruction caused by the storage device and the sharp corners on the weapons rack base constitute a marginal hazard to personnel who may sustain minor injury upon accidental contact. (Shortcoming)

(2) The incorrect color coding of the warning label constitutes a negligible hazard. The color of the label should be red. (Shortcoming)

(3) Due to the inability to open the emergency exit in the required 3 seconds (MIL-STD-1472B, para 5.13.4.2), personnel would not be able to exit expeditiously should a need arise. (Deficiency)

b. AN/TRC-145

(1) The lack of lift caution labels constitutes a marginal hazard to personnel who may sustain injury upon attempting to lift the CV-1548 and AN/GRC-103 radio. (Shortcoming)

(2) The incorrect wording and color coding of the warning label constitutes a negligible hazard. The color of the label should be red. (Shortcoming)

(3) The time to open the smaller door is provided for information only as there are no indications identifying it as an emergency exit.

(4) Due to inability to open the emergency exit in the required 3 seconds, and the absence of an exit label, personnel would not be able to exit expeditiously should a need arise. (Deficiency)

c. Both test items are unsafe to operate and maintain in their present condition because of the deficiencies and shortcomings listed in paragraphs a and b above.

## 2.2 VISUAL AND MECHANICAL INSPECTION

### 2.2.1 Objective

The objective was to determine if each shelter assemblage conformed to standards of good workmanship and is complete with standard components.

### 2.2.2 Criteria (MIL-S-55557A(EL) para 4.17 and MIL-S-55590C(EL), para 4.17)

The equipment shall be examined for the defects listed in MIL-STD-252B and as follows:

#### Classification of Visual and Mechanical Defects

<u>Classification</u>	<u>Defects</u>
Major	<ol style="list-style-type: none"><li>1. Mounting plates missing or mislocated.</li><li>2. Aircraft loading data plate, instruction or nameplate omitted, incorrect or illegible.</li><li>3. Welds - cracked or porous.</li><li>4. Sealer improperly applied (holes, separations, or lack of adhesion).</li><li>5. Mounting inserts missing or mislocated.</li><li>6. Burrs or sharp edges in wire duct not removed.</li><li>7. Equipments or bracketry loose or missing.</li><li>8. Doors, etc. inoperative.</li><li>9. Electrical receptacles, switches, jacks, connections, wire ducts or other electrical components loose, improperly located or inoperative.</li><li>10. Locking or holding devices missing or inoperative.</li><li>11. Gaps between sections of wire duct exceed 1/16 in.</li></ol>
Minor	<ol style="list-style-type: none"><li>1. Doors not easily operable.</li><li>2. Fastening devices difficult to operate.</li><li>3. Abrasions or scratches in finish.</li></ol>

### 2.2.3 Data Acquisition Procedure

The equipment was visually inspected for defects listed in the criteria.

#### 2.2.4 Results

No defects were noted.

#### 2.2.5 Analysis

Each shelter facility conforms to the standards of good workmanship and is complete with standard components.

## 2.3 TOTAL WEIGHT

### 2.3.1 Objective

The objective was to determine each test item's total weight.

### 2.3.2 Criteria (SCL-1280D, para 3.4.2.1)

a. The AN/TRC-117/151, with the full complement of equipment, shall have a maximum gross weight of 5,000 pounds (2273 kilograms).

b. The AN/TRC 145, with the full complement of equipment, shall have a maximum gross weight of 2500 pounds (1136 kilograms).

### 2.3.3 Data Acquisition Procedure

a. The AN/TRC-117/151 was placed on a vehicle, weighed, and the weight of the empty vehicle was subtracted.

b. The AN/TRC-145 was weighed with a hoist scale, subtracting the weight of the slings.

### 2.3.4 Results

a. Total weight AN/TRC-117/151 - 5000 pounds (2273 kg).

b. Total weight AN/TRC-145 - 1475 pounds (670 kg).

### 2.3.5 Analysis

The recorded weights were found to be in compliance with the criteria.

## 2.4 CENTER OF GRAVITY/LATERAL STABILITY

### 2.4.1 Objective

The objective was to determine the center of gravity and calculate the longitudinal and transverse stability of the test items.

### 2.4.2 Criterion (SCL-1280D, para 3.4.2.2.6)

The centers of gravity of the test items shall be such that the angle between a vertical line (90 degrees to baseline) through the center of gravity and a line drawn from the center of gravity to the nearest outer base ground contact point shall be not less than 25 degrees.

### 2.4.3 Data Acquisition Procedure

a. The fully loaded assemblage was suspended by two lifting eyes on the front end plane. The line formed by the intersection of the front and roof planes was held parallel to the ground plane and a plumb line from the front roadside corner was inscribed on the roadside plane.

b. The rear end plane was suspended in a similar manner and a plumb line from the rear roadside corner was inscribed on the roadside plane.

c. The intersection of the two plumb lines located the center of gravity in the longitudinal direction.

d. The preceding procedures were repeated for the roadside-curbside and floor-roof planes to determine the location of the center of gravity for the transverse and vertical directions.

### 2.4.4 Results

a. Two lines were then drawn from the center of gravity as shown in figure 3. One was drawn from the center of gravity to the nearest outer base ground contact point and the other perpendicular to the baseline. The angle formed between the lines was calculated as follows:

$$\alpha = \arctan A/B$$

b. AN/TRC-117/151. Angle  $\alpha$  was calculated from figure 4 as follows:

$$\alpha \geq 25^{\circ} \quad \arctan (100.3/99.1) = 45^{\circ}$$

c. AN/TRC-145. Angle  $\alpha$  was calculated from figure 5 as follows:

$$\alpha \geq 25^{\circ} \quad \arctan (94.5/93.2) = 47^{\circ}.$$

### 2.4.5 Analysis

Angle  $\alpha$  for both test items exceeds the minimum of  $25^{\circ}$ . The criteria is met.

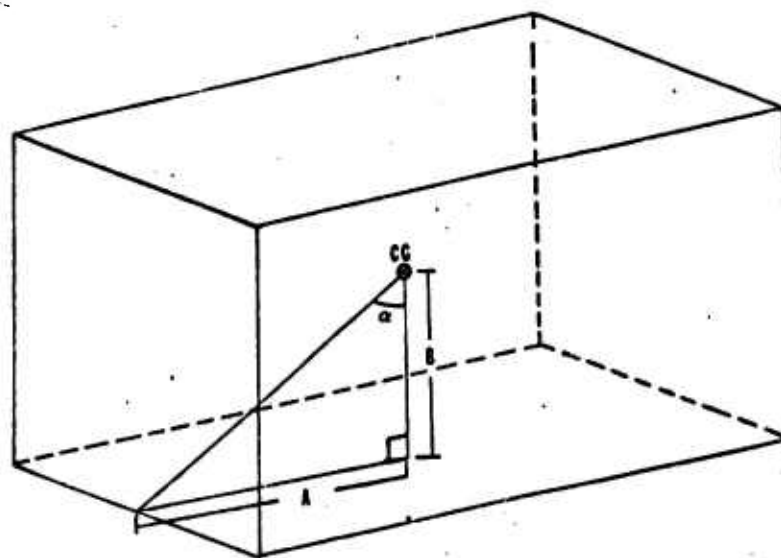
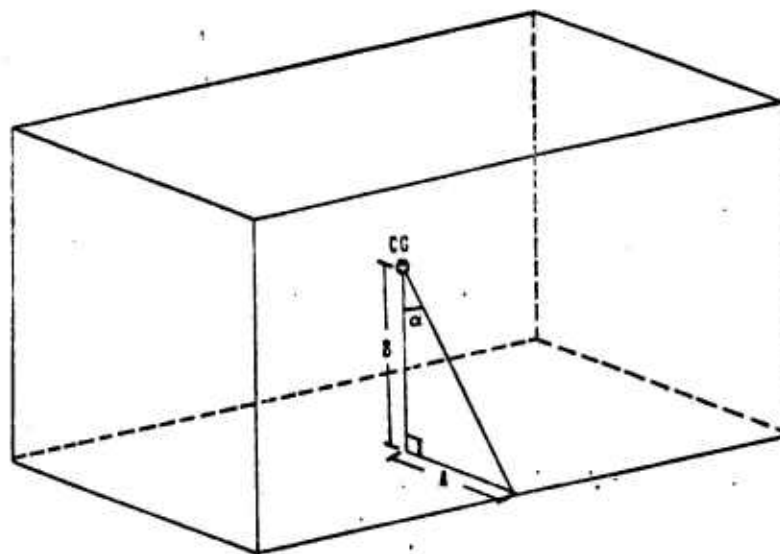
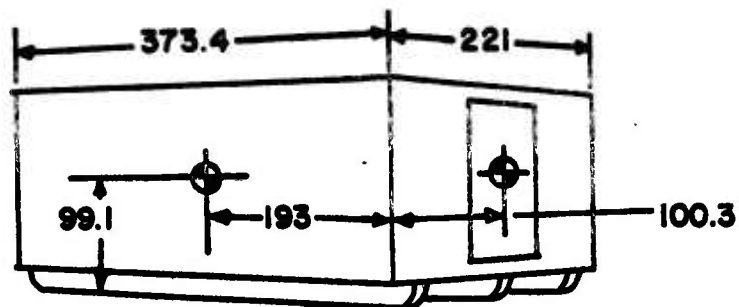
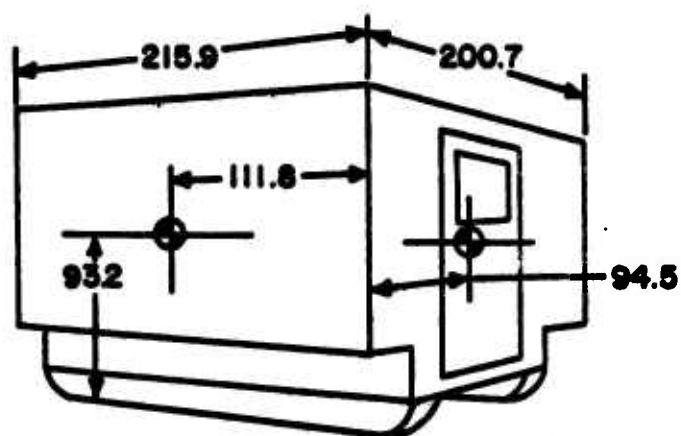


Figure 3. Center of gravity/lateral stability.



ALL MEASUREMENTS IN cm

Figure 4. AN/TRC-117/151 dimensions.



ALL MEASUREMENTS IN cm

Figure 5. AN/TRC-145 dimensions.

## 2.5 WEIGHT DISTRIBUTION

### 2.5.1 Objective

The objective was to determine the distribution of the test item's total weight.

### 2.5.2 Criteria (SCL-1280D, para 3.4.2.2.2)

Weight distribution shall be such that approximately an even load is placed on all corners of the shelter. Lateral unbalance will be permitted up to 5 percent of the gross weight with the roadside of the shelter heavier. Fore and aft unbalance shall not exceed 5 percent of the gross weight of the shelter with the front of the shelter heavier.

### 2.5.3 Data Acquisition Procedure

a. The fore and aft weight distribution was determined mathematically using the formulae in figure 6.

b. The curbside and roadside weight distribution was calculated similarly.

### 2.5.4 Results

a. AN/TRC-117/151. The distribution of weight longitudinally (L) and transversely (T), using the dimensions in figure 4, subtest 2.5, was calculated as follows:

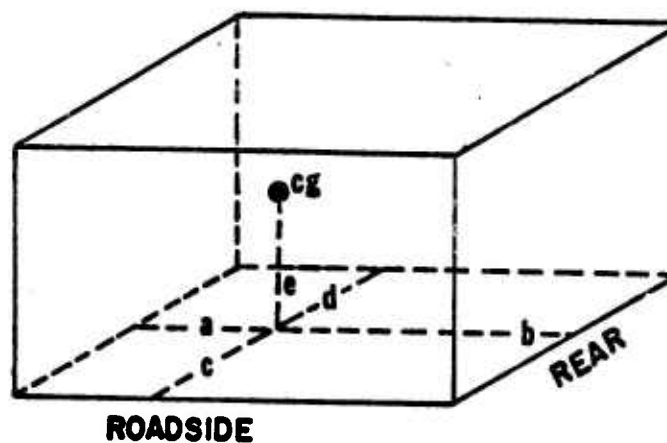
$$0 \leq T \leq 0.050 \quad \frac{c - d}{c + d} = \frac{120.7 - 100.3}{221} = 0.092$$

$$0 \leq L \leq 0.050 \quad \frac{a - b}{a + b} = \frac{193 - 180.3}{373.4} = 0.034$$

b. AN/TRC-145. The distribution of weight longitudinally (L) and transversely (T), using the dimensions in figure 5, subtest 2.5, was calculated as follows:

$$0 \leq T \leq 0.050 \quad \frac{c - d}{c + d} = \frac{106.2 - 94.5}{200.7} = 0.058$$

$$0 \leq L \leq 0.050 \quad \frac{a - b}{a + b} = \frac{111.8 - 104.1}{215.9} = 0.035$$



- a** = LONGITUDINAL DISTANCE FROM cg TO FRONT PLANE  
**b** = LONGITUDINAL DISTANCE FROM cg TO REAR PLANE  
**c** = TRANSVERSE DISTANCE FROM cg TO ROADSIDE PLANE  
**d** = TRANSVERSE DISTANCE FROM cg TO CURBSIDE PLANE  
**e** = VERTICAL DISTANCE FROM SHELTER BOTTOM TO cg  
**cg** = CENTER OF GRAVITY  
**L** = LONGITUDINAL (FORE-AFT) UNBALANCE IN PERCENT  
**T** = TRANSVERSE (ROAD-CURBSIDE) UNBALANCE IN PERCENT  

$$L = \frac{a-b}{a+b} \times 100$$
  

$$T = \frac{c-d}{c+d} \times 100$$

Figure 6. Formulae for weight distribution.

#### 2.5.5 Analysis

a. Neither test item met both 5 percent unbalance limits. (Short-coming)

b. The unbalance did not noticeably degrade either test item's transportability during the vehicular transportation subtest.

## 2.6 OPERABILITY/COMPATIBILITY

### 2.6.1 Objective

The objective was to determine if the system equipment operated satisfactorily and was capable of interface with other ATACS assemblages.

### 2.6.2 Criterion

a. Modification of the Radio Terminal Sets (AN/TRC-145 and AN/TRC-117/151) shall not degrade the operational or system performance characteristics (Approved Test Plan).

b. The insertion loss measured at 1 kHz for each transmission path through the system shall be within the limits of  $\pm 1$  dB. (MIL-STD-188-100, para 4.5.3.7.2).

c. The total harmonic distortion produced by transmitting a 1 kHz test tone through the system shall be at least 30 dB below the power of the test item when the test tone is at a power of -4 dBm. (MIL-STD-188-100, para 4.5.3.9.2).

### 2.6.3 Data Acquisition Procedure

a. The system link configurations of links E, G, and H (figs. 10, 11, and 12, app B) were established during Phase I testing and links C\*H\*, H\*C, and H during Phase II tests.

b. Voice/data subscribers were connected through a Technical Control Center AN/TSQ-84 to provide a routing and circuit testing capability. Each circuit was then tested in the analog mode; digital subscribers were then connected to the system through the AN/TSQ-84 via 26 pair cable (CX-4566) (fig. 13, app B).

c. Performance measurements included measurements taken in both the digital and analog modes:

#### (1) Analog mode.

(a) A 1-kHz test tone was transmitted at -4 dBm and the signal level and total distortion at the far end of the circuit were recorded. Idle channel noise using flat and C-message weighting were also measured. Voice communications were verified by connecting a TA-838 telephone to the subscriber loop and establishing voice communication between the two. No analog measurements were recorded during Phase II testing.

(b) Analog testing was conducted on each channel.

(2) Digital Mode.

(a) BER/BCI tests were run on each test configuration in 24-hour blocks except as indicated in table I. Test instrumentation and equipment performance were monitored continuously during each test. Teletype "quick-brown-fox" messages were transmitted through the system at the rate of one per hour during Phase I.

(b) All testing was conducted in a 12-channel mode of operation.

(c) Channel loading was as shown in figure 13 for Phase I. Single channel loading was used during Phase II.

(d) Phase I was conducted using single link configurations; Phase II tests were conducted using both single and tandem links.

(e) Phase II was initiated after a joint ECOM/USAEPG investigation of the BCI drop-out problem revealed during Phase I was completed. Several problem areas identified during the investigation were eliminated or minimized prior to initiation of Phase II testing.

#### 2.6.4 Results

The results of digital and analog testing of the test items are shown in table I, appendix B. Received teletype copy was free of errors.

#### 2.6.5 Analysis

a. During Phase I testing the systems did not provide a satisfactory digital transmission capability as exhibited by the excessive number of drop-outs occurring during the testing. The cause of these drop-outs could not be determined at that time. Later, during a joint ECOM/USAEPG investigation using link H as a test bed, several sources of drop-outs and error bursts were identified and observed as follows:

(1) Error bursts occurred during lightning storms. Errors were observed to be occurring coincidentally with lightning strikes in the vicinity of the radio receivers. Also, rain storms between transceivers increased the ambient error rate.

(2) Switching generators while transmitting data sometimes produces drop-out/error bursts. They are considered to be due to momentary loss of power or switching transients on the power line.

(3) An intermittently defective TD-754 was isolated at the radio relay site. This TD-754 was used during two of the link H tests during Phase I testing.

(4) Ringing the order wire signaling circuit sometimes produces errors. The above are considered to be the primary causes of the dropouts observed during the Phase I tests.

b. Phase II testing was conducted after replacing the defective TD-754 and using commercial power only. The system performance during Phase II showed a significant improvement over Phase I. The BER exhibited during the testing is considered insignificant in view of the total number of data bits transmitted except for the test using link H alone, where 33,533 errors were accumulated. 19,983 of the 33,533 errors were accumulated over a 2-hour period during a rainstorm with lightning at the receiver location. Only two drop-outs occurred during the period data was being recorded in Phase II tests whereas 96 occurred during Phase I testing. Based only on the data provided, this is not considered to be unsatisfactory performance.

c. A 24-channel radio system with the ability to pass digital traffic could not be established. During many attempts to bring a system up by employing known alignment procedures it was found that experienced operators were no more successful than personnel with little or no experience as operators. It is considered that the problems encountered in establishing a satisfactory circuit of digital transmission quality during this test identifies a need for circuit conditioning and system/technical control procedures and equipment not currently included in the circuit/system configuration. Analog procedures and built-in test equipment currently available to equipment operators and technical controllers do not evaluate the digital transmission capabilities of the various circuits/systems; therefore the only evaluation available to the operator ... if it passes digital traffic, it works ... and digital circuit quality remains unknown for the duration of the operation. In view of the difficulties experienced during this test, complicated by the lack of a built-in digital transmission evaluation capability, the absence of digital test equipment and procedures is considered a deficiency.

d. The range of signal input requirements at the TD-1065 appears to be an extremely narrow limit. These input requirements should be evaluated to determine that signals arriving from distant equipment have a satisfactory likelihood of falling within this range under typical field conditions.

## 2.7 RAIN

### 2.7.1 Objective

The objective was to determine the effectiveness of protective covers or cases to shield the shelter facility from rain.

### 2.7.2 Criteria (MIL-S-55557A(EL), para 3.8 and MIL-S-55590(EL), para 3.8)

Each shelter facility shall be capable of withstanding the water (rain) test prescribed in paragraph 4.12 of MIL-S-55557(EL) and MIL-S-55590(EL) without any leakage into the facility.

### 2.7.3 Data Acquisition Procedure

The shelter facilities AN/TRC-117/151 and AN/TRC-145 were subjected to the rain test prescribed in the criteria. A visual inspection of each shelter interior was made after the test. Holes were drilled around the base of each assemblage to determine if water had entered the shelter panels.

### 2.7.4 Results

No evidence of leakage through the outer skin or into the shelter panels of either shelter was noted.

### 2.7.5 Analysis

Both shelter facilities are capable of withstanding the rain test without leakage.

## 2.8 FORDING

### 2.8.1 Objective

The objective was to determine the ability of the shelter facility to be immersed.

### 2.8.2 Criteria (MIL-S-55557A(EL), para 3.9 and MIL-S-55590C(EL), para 3.9)

The AN/TRC-117/151 shelter facility shall be capable of being immersed in water to a depth of 21 inches (54 cm) and the AN/TRC-145 to a depth of 26 inches (66 cm) measured from the bottom of the skids, for a period of 1 hour without any leakage of water into the shelter.

### 2.8.3 Data Acquisition Procedure

The shelter facilities AN/TRC-117/151 and AN/TRC-145 were subjected to the fording test prescribed in MIL-S-55557A(EL) and MIL-S-55590C(EL). A visual inspection of the shelter interiors were made after the test. Holes were drilled around the base of each assemblage to determine if water had entered the shelter panels.

### 2.8.4 Results

No evidence of leakage through the outer skin or into the shelter panels of either shelter was noted.

### 2.8.5 Analysis

The AN/TRC-117/151 and AN/TRC-145 shelter facilities are capable of being immersed in water to depths of 21 inches (54 cm) and 26 inches (66 cm) respectively (measured from the bottom of the skids) for a period of 1 hour without leakage of water into the facility.

## 2.9 VEHICULAR TRANSPORTATION

### 2.9.1 Objective

The objective was to determine if the shelter facilities are capable of withstanding the stresses normally encountered during vehicular transportation.

### 2.9.2 Criteria (MIL-S-55557A(EL), para 3.5 and MIL-S-55590C(EL), para 3.5)

Both shelter facilities shall be capable of being transported over cross-country terrain by military vehicle without sustaining any damage such as buckling, cracking, delamination, or other permanent deformation.

### 2.9.3 Data Acquisition Procedure

The shelter facilities were subjected to the vehicular transportation test prescribed in paragraph 4.9 of MIL-S-55557A(EL) and MIL-S-55590C(EL). Each shelter was fully loaded with a normal complement of system equipment. After each 10-lap test the shelter facility was inspected for any evidence of structural damage. Operational checks of system equipment as described in paragraph 2.7 of the test plan were performed before and after the test.

### 2.9.4 Results

No degradation or deterioration of system equipment which could prevent the test items from meeting operational requirements, or any permanent structural deformation, was noted.

### 2.9.5 Analysis

Both shelter facilities are capable of being transported over cross-country terrain by military vehicle without sustaining structural damage and without degrading the equipment operational characteristics over the course prescribed by the vehicular transportation test.

## 2.10 DROP

### 2.10.1 Objective

The objective was to determine if the shelter facilities are constructed to withstand the shocks normally encountered during use in the field.

### 2.10.2 Criteria (MIL-S-55557A(EL), para 3.7 and MIL-S-55590C(EL), para 3.7)

Each shelter facility shall be capable of withstanding drops of 18 inches (46 cm) onto concrete. The drops shall cause no damage such as buckling, cracking, delamination, or other permanent deformation.

### 2.10.3 Data Acquisition Procedure

The shelter facilities were subjected to the shelter drop test prescribed in paragraphs 4.11.1 and 4.11.2 of MIL-S-55557A(EL) and MIL-S-55590C(EL). Each shelter was fully loaded with a normal complement of system equipment. After each drop, the shelter facility was inspected for evidence of structural damage. Operational checks of system equipment as described in paragraph 2.7 of the test plan were performed before and after each drop.

### 2.10.4 Results

No degradation or deterioration of system equipment which could prevent the test items from meeting operational requirements, or any permanent structural deformation was noted.

### 2.10.5 Analysis

Both shelter facilities are capable of withstanding drops of 18 inches (46 cm) onto concrete without sustaining structural damage and without degrading the equipment operational characteristics.

## 2.11 RAILROAD TRANSPORTATION

### 2.11.1 Objective

The objective was to determine if the shelter facility is constructed to withstand the shocks normally encountered during rail transportation.

### 2.11.2 Criteria (MIL-S-55557A(EL), para 3.6 and MIL-S-55590C(EL), para 3.6)

Each shelter facility shall be capable of being loaded, blocked, and braced on a flatcar for shipment by rail. When so loaded, the shelter facility shall be subjected to the railroad transportation test of para 4.10 of MIL-S-55557A(EL) and MIL-S-55590C(EL), and shall be capable of withstanding the test without sustaining any damage such as buckling, cracking, delamination, or other permanent deformation.

### 2.11.3 Data Acquisition Procedure

Each shelter facility was subjected to the railroad transportation test prescribed in the criteria. The shelters were fully loaded with a normal complement of system equipment. Operational checks of system equipment as described in paragraph 2.7 of the test plan were performed before and after the test.

### 2.11.4 Results

a. Following the last impact of the rail impact test of the AN/TRC-117/151 a final inspection was conducted. The findings were a bent Z bar, a broken bolt, a small tear in the inner skin of the shelter, and evidence of washers on bolts retaining Z bars pulling through the holes in the Z bars. The racks were removed and larger washers were installed (the size called for in the specifications).

b. As a result of the second impact of the AN/TRC-145, the TD-660 racks loosened from the wall, three bolts holding the racks to the hat section pulled through. This was beginning to happen in a number of other places. As a result of the damage sustained in the second impact, the test was aborted.

### 2.11.5 Analysis

Results indicate that neither test item is capable of withstanding shipment by rail without sustaining permanent damage (Deficiency). This is considered a deficiency since following shipment by rail neither assemblage would likely be capable of being fielded for immediate operation.

## 2.12 MAINTENANCE EVALUATION

### 2.12.1 Objective

The objective was to acquire maintenance/maintainability data on the test item.

### 2.12.2 Criterion

The test items shall comply with requirements of AR 702-3, para 2-5c.

### 2.12.3 Data Acquisition Procedure

a. Detailed maintenance logs were maintained throughout the test. Scheduled and unscheduled maintenance, equipment failures, and the methods used to repair the test items were recorded.

b. Equipment publications, tools, test measurement and diagnostic equipment (TMDE), and repair parts were examined for adequacy.

c. Personnel of military occupational specialty (MOS) 31E, 31L, and 26L were utilized to perform maintenance operations.

d. Soldier operator/maintainer personnel (SOMTE) comments were solicited.

### 2.12.4 Results

a. The test items accumulated the following operating hours with no chargeable failures attributable to assemblage modifications for the TD-1065 and TD-1069:

AN/TRC-117 SN 0044	686 hours
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AN/TRC-145 SN 1810A	691 hours
---------------------	-----------

b. Simulated maintenance and failures not attributable to modification are reported for each test item in the maintenance analysis chart (app D).

c. DEP TM 11-5895-366-14-1 and DEP TM 11-5895-453-14-1 are incomplete. The manual does not include specific cable interconnect instructions for the various modes of operation. The manual does not include organizational troubleshooting procedures for the TD-1065 and TD-1069. The Repair parts list and special tools list are missing. The block diagrams do not incorporate the TD-1065 and TD-1069 as part of a system.

d. Repair parts consisted of replacement modules for the multiplexers in the AN/TRC-117/151 and AN/TRC-145. Replacement modules were in sufficient quantity for the faults experienced during the test after

the receipt of two additional module replacement sets from ECOM and TOAD. Repair parts for the product improved portion were not required. No failures on the PI portions were experienced during the test.

e. Tool Kit TK-105/G, oscilloscope AN/USM-281A and multimeter TS 352 were utilized satisfactorily for the performance of maintenance operations required during the test. There were no requirements for special tools or test equipments.

f. SOMTE comments. See appendix E.

#### 2.12.5 Analysis

a. A chargeable failure was defined as any malfunction of the modification which could not be remedied by adjustment, repair, or replacement action within 5 minutes and which caused or may cause:

(1) Failure to commence operation, cessation of operation, or degradation of performance below specified limits.

(2) Serious damage to the test item by continued operation.

(3) Serious personnel safety hazards.

b. A point estimate mean-time-between-failure (MTBF) could not be computed for either test item based on zero assemblage modification failures.

c. Maintainability parameters were not computed. All maintenance performed or simulated is displayed in appendix D.

d. DEP TM 11-5895-366-14-1 and DEP TM 11-5895-483-14-1 are inadequate in that the procedures are incomplete and prevent operator personnel from performing necessary functions. (Deficiency)

e. Repair parts are necessary and adequate in quantity for the faults experienced during the test.

f. The tools and test equipment used during the test are adequate for their intended use.

## 2.13 HUMAN ENGINEERING (AN/TRC-117/151)

### 2.13.1 Objective

The objective is to determine whether the characteristics of the item are compatible with human capacities and limitations.

### 2.13.2 Criteria

a. The maximum steady state noise shall not exceed values shown below: (MIL-STD-1474(MI), Category F, para 5.1.1)

<u>Octave Band Limits</u> (Hz)	<u>Center Frequency</u> (Hz)	<u>Noise Level</u> (dB)*
44 - 87	63	77
87 - 175	125	72
175 - 350	250	67
350 - 700	500	63
700 - 1400	1000	61
1400 - 2800	2000	59
2800 - 5600	4000	58
5600 - 11200	8000	57

\*Ref 0.0002 microbar

b. Equipment characteristics shall be compatible with human capabilities and limitations. (MIL-STD-1472B, para 3.18)

c. Work space dimensions shall be designed so that they will accommodate all required operations. In addition, workspace dimensions shall provide space for bodily movements required for official tasks performed by personnel whose physical size is from 64 to 75 inches (162.5 to 190.5 cm) in height. (MIL-STD-1472B, para 5.6.1)

d. Controls, displays, and any other items of equipment that must be located, identified, read, or manipulated shall be appropriately and clearly labeled to permit rapid and accurate human performance. No label will be required on equipment or controls whose use is obvious to the user. Cables and connectors must be labeled to prevent mismatching and/or incorrect connections. (MIL-STD-1472B, para 5.5.1.1)

e. The built-in test facilities shall be designed so that rapid performance evaluation can be made by semi-skilled personnel. (MIL-STD-415B, para 5.1.1.1.)

### 2.13.3 Data Acquisition Procedure

a. A steady-state noise level by octave bands was taken for each operator position. Measurements were taken with the microphone of the sound level meter placed at ear level. The ambient or surrounding noise level was measured first with no equipment operating. Then each group of equipment was activated in succession so that it became obvious which group contributes most to the overall sound level.

b. Soldier operator/maintainer personnel performed the tasks normally associated with assembly and disassembly. During the performance a human factors specialist examined any HFE difficulties. These were recorded onto videotape for additional examination.

c. To determine the adequacy of space accommodation, personnel representing the 5th and 95th percentile occupied the operator positions and executed various reaching actions. Procedure and findings of removing TD-1065 and TD-1069 out of the system mounting racks are covered in the "maintainability" section of the report.

d. The adequacy of the labeling from the HFE standpoint was determined by inspection.

e. Characteristics of the built-in test equipment were determined through operation and inspection.

### 2.13.4 Results

a. The following noise measurements were taken from test item, serial number 0114-1478B: (Sound level meter calibrated to Ref level of 0.00002 microbar)

A	B	C	D	E
Center Frequency	Criteria	Ambient	Comm	2
(Hz)	(dB)	(dB)	Gear	Blowers
			(dB)	(dB)
63	77	50	59	75
125	72	53	56	81
250	67	44	56	79
500	63	42	55	69
1000	61	37	53	71
2000	59	32	57.5	69
4000	58	26	52	65
8000	57	22	46	64

Col A, center frequency of octave band measured

Col B, Criteria (Category F of MIL-STD-1474)

Col C, ambient noise level (this unit has power supplied from commercial source during noise measurement.)

Col D, all communications equipment operating

Col E, same as "D" plus 2 blowers operating

Note: The test item does not have a self-contained air conditioner, but does have provisions for hooking onto flexible ducts from a central air conditioning unit.

b. Soldier operator/maintainer personnel were able to perform the tasks normally required in typical military use. However, the large vent cover on the shelter door presented a problem for the operator on a windy day. The wind blew the vent cover causing it to disengage from its latch and close. The operator had to wire the latch on a windy day.

c. Work space dimensions provided adequate space for performance of operator tasks.

d. Controls, displays, and other items which must be located, identified and manipulated were appropriately and clearly labeled to permit rapid and accurate human performance.

e. The built-in test equipment provided rapid operational check by semi-skilled operators.

#### 2.13.5 Analysis

a. The noise measurements do not include noise generated from air conditioning because the test item is air conditioned through connection to a central unit. How much additional noise is derived from this source was not determined because a central air conditioning unit was not available for this test. The two rear mounted blowers produced a noise level inside the shelter which exceeded the criterion in octave bands 125 Hz through 8000 Hz. Noise levels of this magnitude will impair efficiency of verbal communications.

b. On windy days the operator will be required to leave his work station frequently to re-position the vent cover on the door. This is annoying and uses time which could be applied to productive tasks.

c. The shelter provided adequate space for the operator to accomplish required tasks.

d. Labeling characteristics of the test item were satisfactory.

e. The operation of the built-in test equipment was satisfactory.

f. The noise problem (a) created by the 2 blowers and the wind-sensitive vent cover (b) on the door constitute a shortcoming from the standpoint of HFE.

## 2.14 HUMAN ENGINEERING (AN/TRC-145(V))

### 2.14.1 Objective

The objective was to determine whether the characteristics of the item are compatible with human capacities and limitations.

### 2.14.2 Criteria

- a. The maximum steady state noise shall not exceed values shown below: (MIL-STD-1474(MI), Category F, para 5.1.1)

<u>Octave Band Limits (Hz)</u>	<u>Center Frequency (Hz)</u>	<u>Noise Level (dB)*</u>
44 - 87	63	77
87 - 175	125	72
175 - 350	250	67
350 - 700	500	63
700 - 1400	1000	61
1400 - 2800	2000	59
2800 - 5600	4000	58
5600 - 11200	8000	57

\*Ref 0.0002 microbar

- b. Equipment characteristics shall be compatible with human capabilities and limitations. (MIL-STD-1472B, para 3.18)

c. Work space dimensions shall be designed so that they will accommodate all required operations. In addition, workspace dimensions shall provide space for bodily movements required for official tasks performed by personnel whose physical size is from 64 to 75 inches (162.5 to 190.5 cm) in height. (MIL-STD-1472B, para 5.6.1)

d. Controls, displays, and any other items of equipment that must be located, identified, read, or manipulated shall be appropriately and clearly labeled to permit rapid and accurate human performance. No label will be required on equipment or controls whose use is obvious to the user. Cables and connectors must be labeled to prevent mismatching and/or incorrect connections. (MIL-STD-1472B, para 5.5.1.1)

e. The built-in test facilities shall be designed so that rapid performance evaluation can be made by semi-skilled personnel. (MIL-STD-415B, para 5.1.1.1)

### 2.14.3 Data Acquisition Procedure

a. A steady-state noise level by octave bands was taken for each operator position. Measurements were taken with the microphone of the sound level meter placed at ear level. The ambient or surrounding noise level was measured first with no equipment operating. Then each group of equipment was activated in succession so that it became obvious which group contributes most to the overall sound level.

b. Soldier operator/maintainer personnel performed the tasks normally associated with assembly and disassembly. During the performance a human factors specialist examined any HFE difficulties. These were recorded onto videotape for additional examination.

c. To determine the adequacy of space accommodation, personnel representing the 5th and 95th percentile occupied the operator positions and executed various reaching actions. Procedure and findings of removing TD-1065 and TD-1069 out of the system mounting racks are covered in the "maintainability" section of the report.

d. The adequacy of the labeling from the HFE standpoint was determined by inspection.

e. Characteristics of the built-in test equipment were determined through operation and inspection.

### 2.14.4 Results

a. The following noise measurements were taken from test item, serial number 1810A: (Reference level of sound level meter is 0.0002 microbar.)

A	B	C	D	E
Center Frequency	Criteria	Ambient	Comm	2
(Hz)	(dB)	(dB)	Gear	Blowers
			(dB)	(dB)
63	77	60	60	70
125	72	56	59	71
250	67	58	61	75
500	63	48	60	73
1000	61	42	62	73
2000	59	39	62	70
4000	58	38	57	64
8000	57	28	53	61
dB (A)	85	51	67	77

Col A, center frequency of octave band measured.

Col B, Criteria (Category F of MIL-STD-1474)

Col C, ambient noise level (includes noise of 5 kW generator which was operating 101 feet (30.8 m) away from test item.

Col D, all communications equipment operating.

Col E, same as D above plus 2 blowers operating.

Note: The test item does not have a self-contained air conditioner, but does have provisions for hooking onto flexible ducts from a central air conditioning unit.

b. Soldier operator/maintainer personnel were able to perform the tasks normally required in typical military use. However, the operators encountered the following problems:

(1) The coat rack was located above the air conditioner intake grille. When a coat is placed on the hook it will obstruct the circulation of air from the personnel enclosure to the central air conditioning unit.

(2) The patch panel used the old-type connector shown on the left in figure 7. This connector requires more space and time to accomplish patching and is more difficult to use than the newer type shown on the right in same figure.

(3) The device which holds the door open was awkward in operation. It required insertion of a pin to lock the door in the open position (Figure 8). The pin usually wedged at an angle as shown in the photograph and was difficult to remove. A simpler and more effective locking device was found on the AN/TCC-73 as shown in figure 9.

(4) The indicator lights which denote primary power were coded red for "power on" condition. Normally red warns the operator of a "malfunction" or "no-go" condition.

c. Work space dimensions were adequate for performance of operator tasks. However, since the shelter has such a low ceiling, no one above the 5th percentile in standing height could stand erect in the shelter.

d. Controls, displays, and other items which must be located, identified, and manipulated were appropriately and clearly labeled to permit rapid and accurate human performance.

e. The built-in test equipment provided rapid operational check by semi-skilled operators.

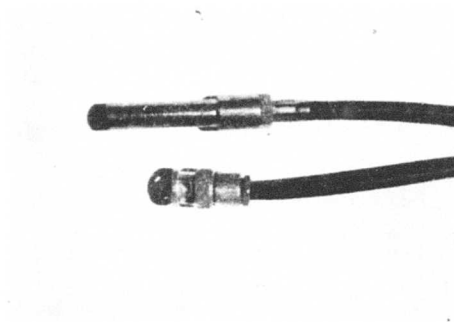


Figure 7. Old connector (left)  
and new connector (right)

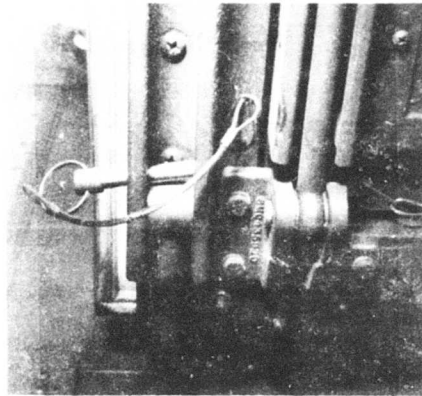


Figure 8. Door locked with pin.

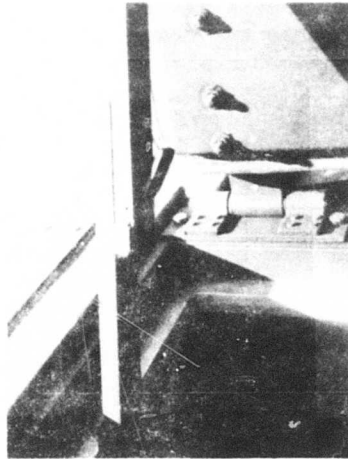


Figure 9. Door locked with  
locking device.

#### 2.14.5 Analysis

a. The noise measurements do not include noise generated from air conditioning because the test item is air conditioned through connection to a central unit. How much additional noise is derived from this source was not determined because a central air conditioning unit was not available for this test. The noise level inside the shelter exceeded criterion in octave bands 250 Hz through 8 kHz. Noise levels of this magnitude will impair efficiency of verbal communications.

b. The following concerns features which require performance which is incompatible with the human limitations and capacities:

(1) Use of the coat rack will impair satisfactory operation of the air conditioning system.

(2) An excessive amount of space and time is required for patching with the old-type connector as compared with the newer type.

(3) Operation of the device which locks the shelter door in the open position is unsatisfactory.

(4) Mis-use of color coding results in inefficient man-machine relationships.

c. The shelter provides adequate space for the operator to accomplish required tasks as long as he performs these while seated in the chair provided.

d. Labeling characteristics of the test item were satisfactory.

e. The operation of the built-in test equipment is satisfactory.

f. The difficulties described in a and b above constitute a shortcoming from the standpoint of HFE.

# APPENDIX A. TEST CRITERIA

Item	Source	Criteria	Applicable Subtest	Remarks
1		The test item shall meet the pertinent safety requirements of MIL-STD-454C, MIL-STD-1472A, and SCL-1280D.	2.1	Not met. See Deficiency 1.1 and Shortcoming 2.1, app C.
2	MIL-S-55557A(EL), para 4.17 and MIL-S-55590C(EL), para 4.17	The equipment shall be examined for the defects listed in MIL-STD-252B and para 2.2.2 of this report.	2.2	Met.
3	SCL-1280D, para 3.4.2.1	The AN/TRC 117/151, with the full complement of equipment, shall have a maximum gross weight of 5,000 pounds (2273 kilograms).	2.3	Met.
4	SCL-1280D, para 3.4.2.1	The AN/TRC 145, with the full complement of equipment, shall have a maximum gross weight of 2560 pounds (1136 kilograms).	2.3	Met.
5	SCL-1280D, para 3.4.2.2.6	The centers of gravity of the test items shall be such that the angle between a vertical line (90 degrees to baseline) through the center of gravity and a line drawn from the center of gravity to the nearest outer base ground contact point shall be not less than 25 degrees.	2.4	Met.
6	SCL-1280D, para 3.4.2.2.2	Weight distribution shall be such that approximately an even load is placed on all corners of the shelter. Lateral imbalance will be permitted up to 5 percent of the gross weight with the road-side of the shelter heavier. Fore and aft imbalance shall not exceed 5 percent of the gross weight of the shelter with the front of the shelter heavier.	2.5	Not met. See Shortcoming 2.2, app C.

Item	Source	Criteria	Applicable Subtest	Remarks
7	Approved Test Plan	Modification of the Telephone Terminal Sets (AN/TRC-145 and AN/TRC-117/151) shall not degrade the operational or system performance characteristics.	2.6	Not met. See Deficiency 1.2, app C.
8	MIL-STD-188-100, para 4.5.3.7.2	The insertion loss measured at 1 kHz for each transmission path through the system shall be within the limits of $\pm 1$ dB.	2.6	Met.
9	MIL-STD-188-100, para 4.5.3.9.2	The total harmonic distortion produced by transmitting a 1 kHz test tone through the system shall be at least 30 dB below the power of the test tone when the test tone is at a power of -4 dBm.	2.6	Met.
10	MIL-S-55557A(EL), para 3.8 and MIL-S-55590(EL), para 3.8	Each shelter facility shall be capable of withstanding the water (rain) test prescribed in paragraph 4.12 of MIL-S-55557(EL) and MIL-S-55590(EL) without any leakage into the facility.	2.7	Met.
11	MIL-S-55557A(EL), para 3.9 and MIL-S-55590C(EL), para 3.9	The AN/TRC-117/151 shelter facility shall be capable of being immersed in water to a depth of 21 inches (54 cm) and the AN/TRC-145 to a depth of 26 inches (66 cm) measured from the bottom of the skids, for a period of 1 hour without any leakage of water into the shelter.	2.8	Met.
12	MIL-S-55557A(EL), para 3.5 and MIL-S-55590C(EL), para 3.5	Both shelter facilities shall be capable of being transported over cross-country terrain by military vehicle without sustaining any damage such as buckling, cracking, delamination, or other permanent deformation.	2.9	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
13	MIL-S-55557A(EL), para 3.7 and MIL-S-55590C(EL), para 3.7	Each shelter facility shall be capable of withstanding drops of 18 inches (46 cm) onto concrete. The drops shall cause no damage such as buckling, cracking, delamination, or other permanent deformation.	2.10	Met.
14	MIL-S-55557A(EL), para 3.6 and MIL-S-55590C(EL), para 3.6	Each shelter facility shall be capable of being loaded, blocked, and braced on a flat-car for shipment by rail. When so loaded, the shelter facility shall be subjected to the railroad transportation test of para 4.10 of MIL-S-55557A(EL) and MIL-S-55590C(EL), and shall be capable of withstanding the test without sustaining any damage such as buckling, cracking, delamination, or other permanent deformation.	2.11	Not met. See Deficiency 1.3, app C.
15		The test item shall comply with requirements of AR 702-3, para 2-5c.	2.12	Not met. See Deficiency 1.4, app C.
16	MIL-STD-1474(MI), Category F, para 5.1.1	The maximum steady state noise shall not exceed values shown in para 2.14.2 of this report.	2.13	Not met. See Shortcoming 2.3, app C.
17	MIL-STD-1472A, para 3.18	Equipment characteristics shall be compatible with human capabilities and limitations.	2.13	Not met. See Shortcoming 2.4, app C.
18	MIL-STD-1472A, para 5.6.1	Work space dimensions shall be designed so that they will accommodate all required operations. In addition, workspace dimensions shall provide space for bodily movements required for official tasks performed by personnel whose physical size is from 64 to 75 inches (162.5 to 190.5 cm) in height.	2.13	Met.

Item	Source	Criteria	Applicable		Remarks
			Subtest		
19	MIL-STD-1472A, para 5.5.1.1	Controls, displays, and any other items of equipment that must be located, identified read, or manipulated shall be appropriately and clearly labeled to permit rapid and accurate human performance. No label will be required on equipment or controls whose use is obvious to the user. Cables and connectors must be labeled to prevent mismatching and/or incorrect connections.	2.13	Met.	
20	MIL-STD-415B, para 5.1.1.1	The built-in test facilities shall be designed so that rapid performance evaluation can be made by semi-skilled personnel.	2.13	Met.	
21	MIL-STD-1474(MI), Category F, para 5.1.1	The maximum steady state noise shall not exceed values shown in para 2.15.2 of this report.	2.14	Not met. See Shortcoming 2.5, app C.	
22	MIL-STD-1472B, para 3.18	Equipment characteristics shall be compatible with human capabilities and limitations.	2.14	Not met. See Shortcoming 2.6, app C.	
23	MIL-STD-1472B, para 5.6.1	Work space dimensions shall be designed so that they will accommodate all required operations. In addition, workspace dimensions shall provide space for bodily movements required for official tasks performed by personnel whose physical size is from 64 to 75 inches (162.5 to 190.5 cm) in height.	2.14	Met.	

Item	Source	Criteria	Applicable	
			Subtest	Remarks
24	MIL-STD-1472B, para 5.5.1.1	Controls, displays, and any other items of equipment that must be located, identified, read, or manipulated shall be appropriately and clearly labeled to permit rapid and accurate human performance. No label will be required on equipment or controls whose use is obvious to the user. Cables and connectors must be labeled to prevent mismatching and/or incorrect connections.	2.14	Met.
25	MIL-STD-415B, para 5.1.1.1	The built-in test facilities shall be designed so that rapid performance evaluation can be made by semi-skilled personnel.	2.14	Met.

APPENDIX B. TEST DATA

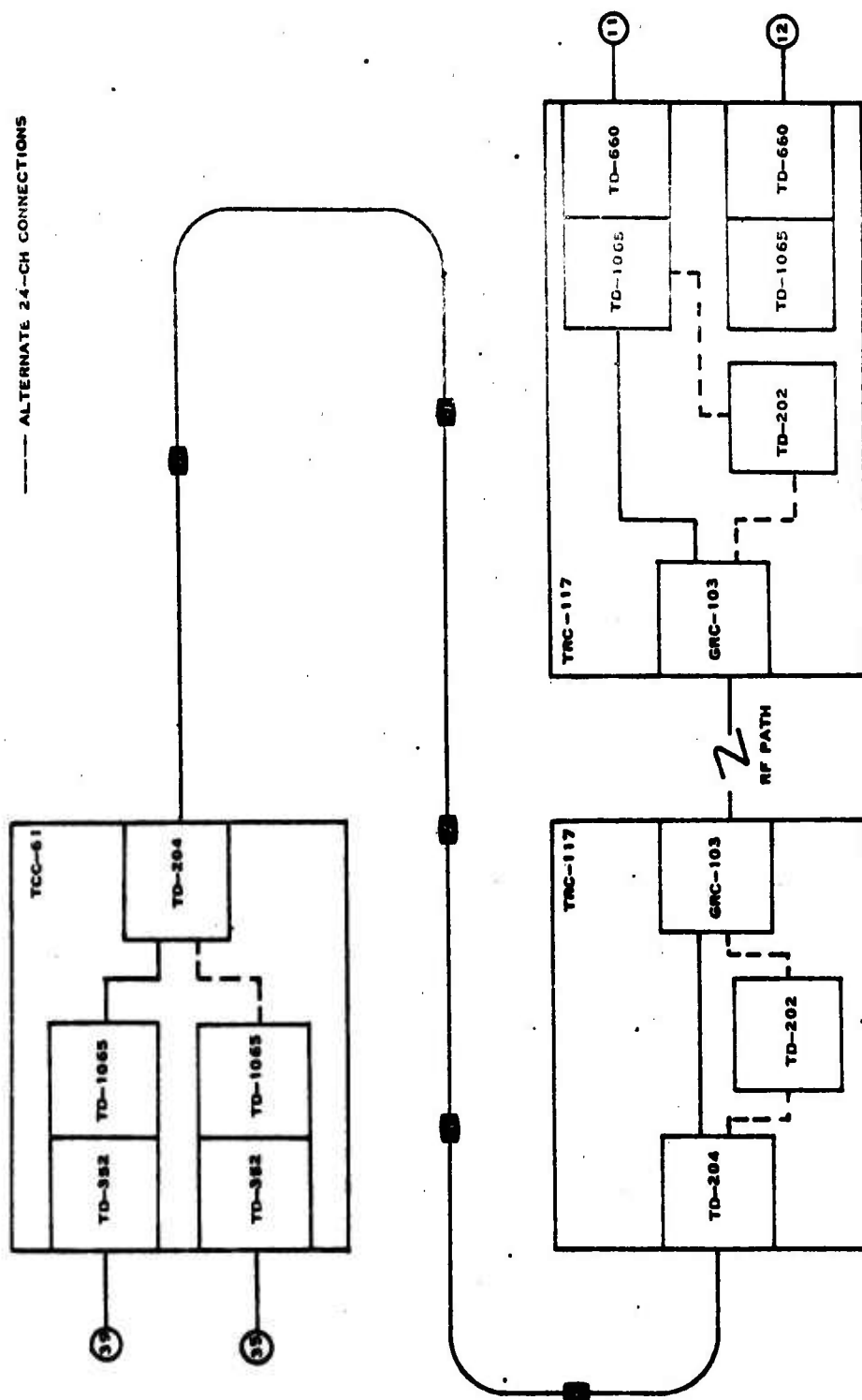


Figure 11. Link E configuration AN/TCC-61 to AN/TRC-117/151.

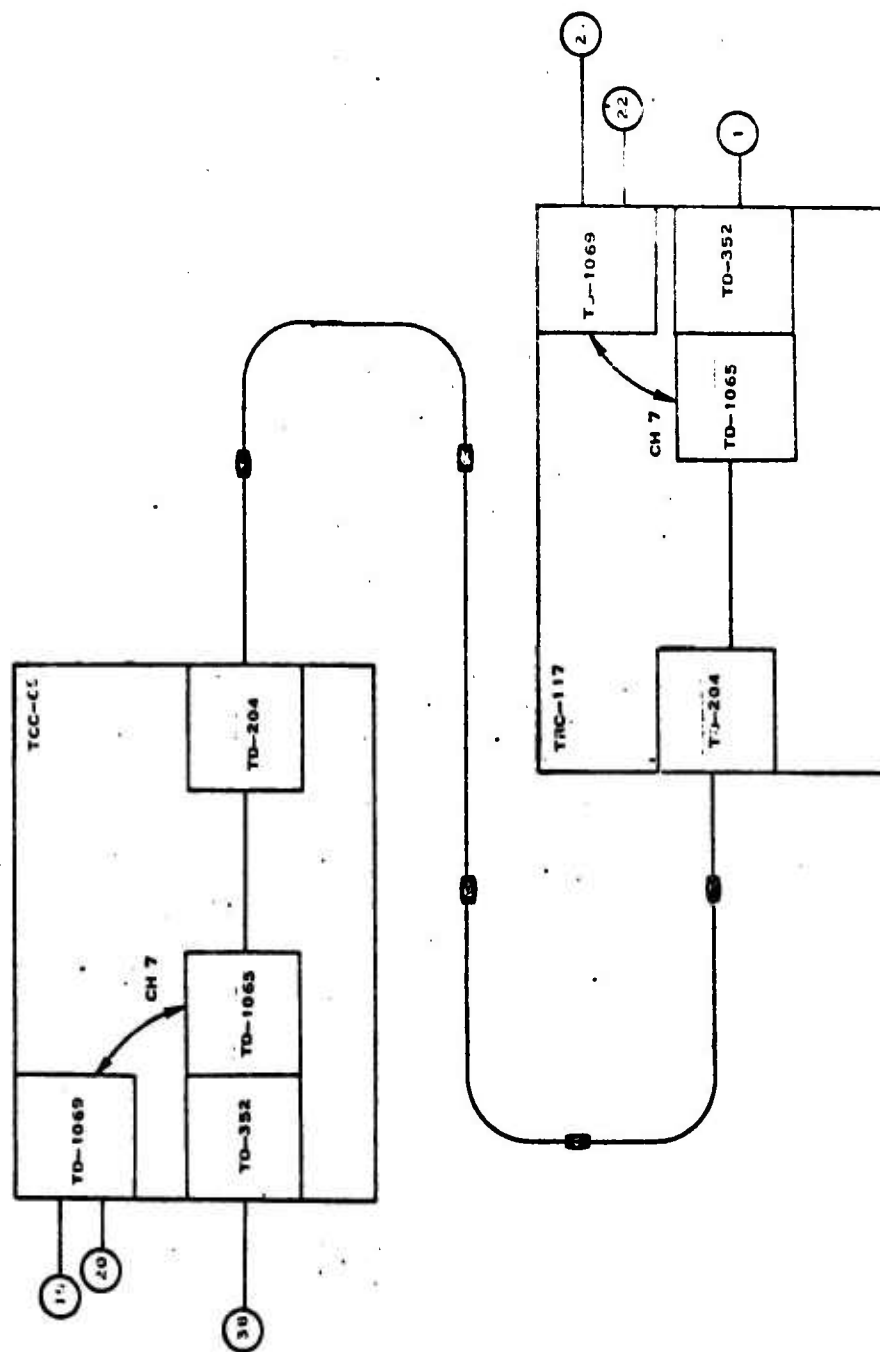


Figure 12. Link G configuration AN/TCC-69 to AN/TRC-117/151.

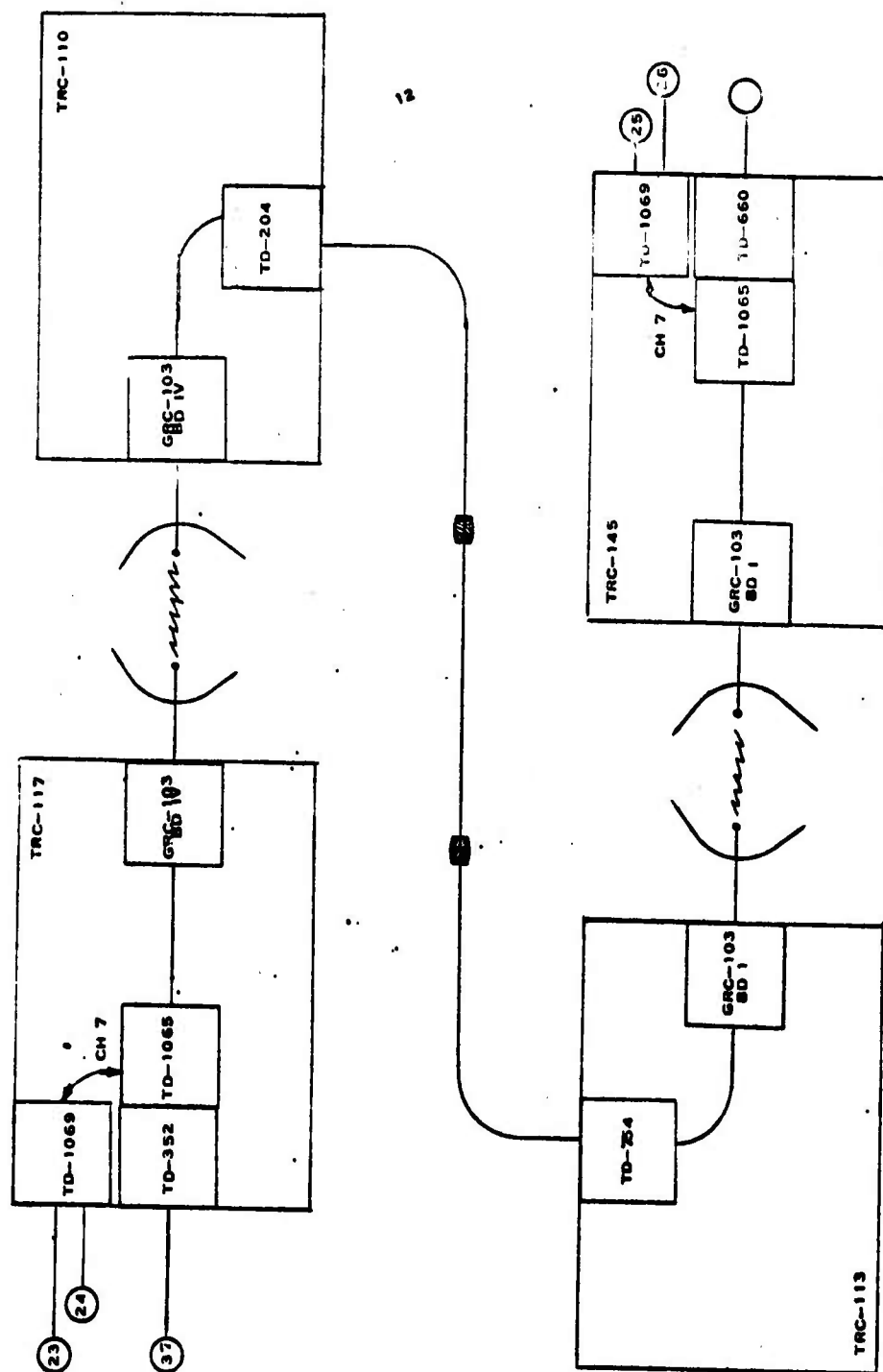


Figure 13. Link H (modified) configuration AN/TRC-117/151 to AN/TRC-145.

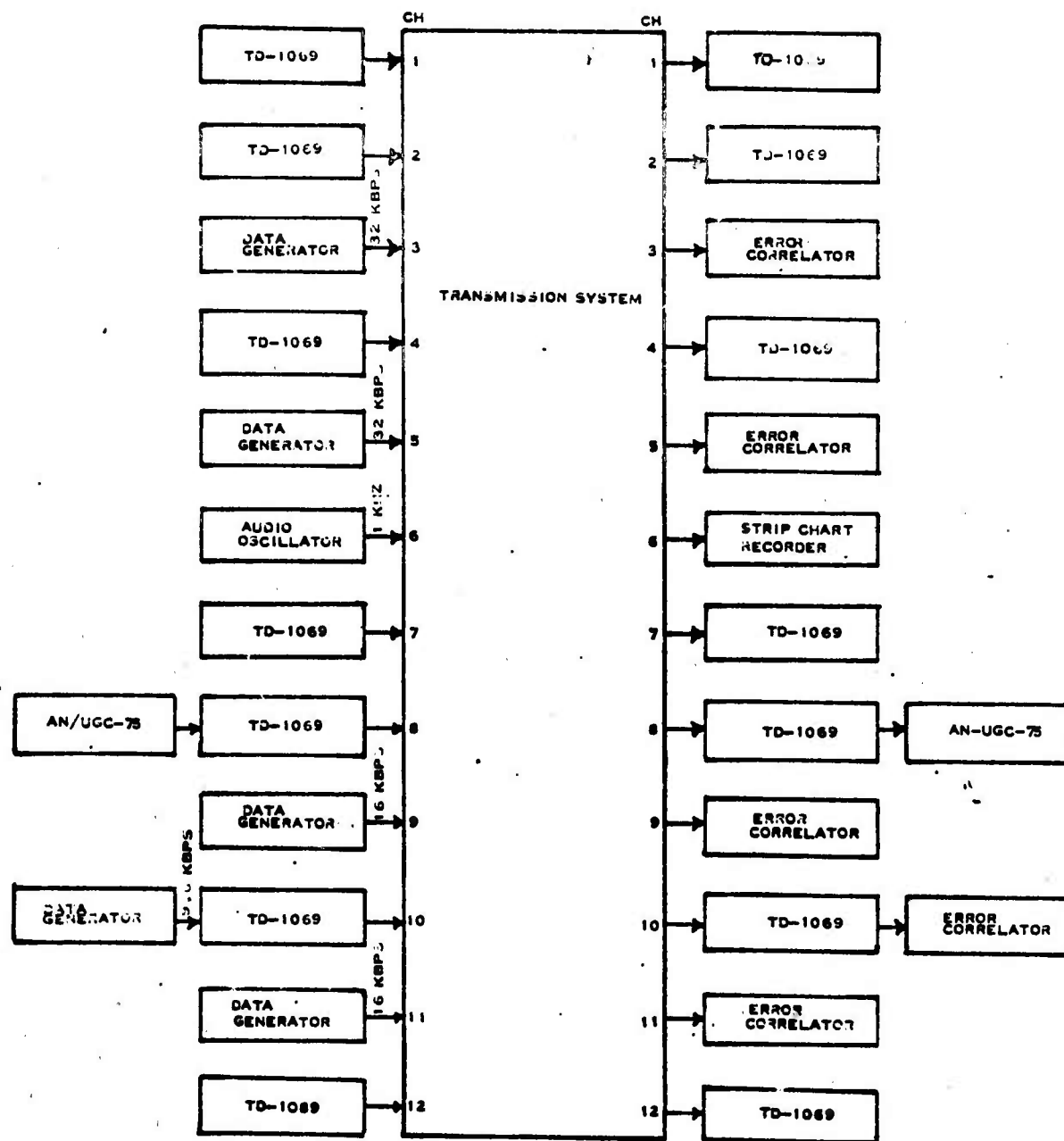


Figure 14. Digital subscriber connections through the technical control center.

TABLE I. BER/BCI TESTS

Test No.	Test Configuration	Power Source	Total Drop-Outs*	Total Random Errors	Test Length (Hours)
(Phase I)					
1	Link E	Gen	5	7	24
2	Link G	Gen	7	0	24
3	Link H	Gen	25	31	24
4	Link H	Comm	14	39	24
5	Link H (TD-204 in TRC-100 replaced with TD-754)	Gen	12	0	24
6	Link H-A (Loop-back to provide GRC-103 (Band I) only)	Comm	10	85	16
7	Link H-B (Loop-back to provide GRC-103 (Band IV) only)	Comm	<u>7</u>	<u>0</u>	<u>24</u>
Phase I Totals			96	183	321
(Phase II)					
1	Tandem Links (Link C	Comm	1	14	39
2	Link H	Comm	<u>1</u>	<u>33533</u>	<u>24</u>
Phase II Totals			2	33629	130

\*A "drop-out" is defined as a loss of system synchronization resulting in a loss of BCI.

APPENDIX C. DEFICIENCIES, SHORTCOMINGS AND SUGGESTED IMPROVEMENTS

1. DEFICIENCIES

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
1.1 Both assemblages fail to meet requirements in the Safety subtest. (Para 2.1.4)		Due to the inability to open the emergency exit in the required 3 seconds (and lack of labeling on the AN/TkC-145), personnel would not be able to exit expeditiously should the need arise.
1.2 Modification to both Radio Terminal Sets degrades operational performance characteristics. Operability/Compatibility subtest. (Para 2.6.4)		A 24-channel radio system with the ability to pass digital traffic could not be established. During many attempts to bring a system up by employing known alignment procedures it was found that experienced operators were no more successful than personnel with little or no experience as operators. It is considered that the problems encountered in establishing a satisfactory circuit of digital transmission quality during this test identifies a need for circuit conditioning and system/technical control procedures and equipment not currently included in the circuit/system configuration. Analog procedures and built-in test equipment currently available to equipment operators and technical controllers do not evaluate the digital transmission capabilities of the various circuit/systems; therefore, the

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
		only evaluation available to the operator is ...if it passes digital traffic, it works... and digital circuit quality remains unknown for the duration of the operation.
1.3 Both assemblages failed the Railroad Transportation subtest. (Para 2.11.4)		Neither test item is capable of withstanding shipment by rail without sustaining permanent damage.
1.4 TMs inadequate for both test items. (Para 2.12.4)		Procedures in the TMs are incomplete and prevent operator personnel from performing necessary functions.

## 2. SHORTCOMINGS

<u>Shortcoming</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
2.1 The following shortcomings were found during performance of the Safety subtest. (Para 2.1.5)		
a. AN/TRC-117/151.		
(1) Obstructions and sharp corners present.		The obstruction caused by the storage device and the sharp corners on the weapons rack base constitute a marginal hazard to operating personnel.
(2) Incorrect color coding of the warning label.		The warning label should be red instead of black.

<u>Shortcoming</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
b. AN/TRC-145.		
(1) Lift caution labels missing.		The lack of lift caution labels constitutes a marginal hazard to operating personnel.
(2) Incorrect color coding of the warning label.		The warning label should be red instead of black.
2.2 Both test items failed to meet the 5 percent unbalance limits. (Para 2.5.4)		
2.3 AN/TRC-117/151 exceeds minimum noise level criteria.		The two air conditioning blowers produced a noise level inside the shelter which exceeded the criterion in octave bands 125 Hz through 8 kHz.
2.4 A wind sensitive vent cover on AN/TRC-117/151 is incompatible with human capabilities.		On windy days the operator must leave his station frequently to reposition the vent cover on the door.
2.5 AN/TRC-145 exceeds minimum noise level criteria.		Noise derived from air conditioning unit produced a noise level inside the shelter which exceeded the criterion in octave bands 250 Hz through 8 kHz.
2.6 The following features in the AN/TRC-145 are incompatible with human limitations and capabilities.		
a. Use of a coat rack blocks operation of air conditioning system.		

Shortcoming	Suggested Corrective Action	Remarks
b. Patching unsatisfactory.	Use of the newer type connector as used in AN/TCC-73 would increase efficiency.	An excessive amount of time and space is required for patching with the old-type connector.
c. Shelter door locking device is unsatisfactory.	A simpler and more effective locking device, as found on AN/TCC-73 would remove this problem.	The device which holds the door open wedged at an angle and was difficult to remove.
d. Misuse of color coding.		The indicator lights which denote "primary power on" were coded "red" which normally warns the operator of a "malfunction".

APPENDIX D. MAINTENANCE EVALUATION

**MAINTENANCE ANALYSIS CHART INSTRUCTION SHEET**

**DESCRIPTION**

**COLUMN**

- 1 **GROUP AND SEQUENCE NUMBERS.** FUNCTIONAL GROUP NUMBER AS INDICATED IN THE MAINTENANCE ALLOCATION CHART (OR TB-750-93-1) OF THE ASSEMBLY OR SUBASSEMBLY. THE SEQUENCE NUMBER OF THE MAINTENANCE ACTION IS IN PARENTHESES BELOW THE GROUP NUMBER.
- 2 **COMPONENT AND RELATED OPERATIONS.** COMPONENT AND RELATED MAINTENANCE FUNCTIONS AS INDICATED IN THE MAINTENANCE ALLOCATION CHART. MAINTENANCE FUNCTIONS ASSIGNED TO DEPOT CATEGORY MAINTENANCE ARE NOT NORMALLY SHOWN.
- 3 **SUBSYSTEM ID.** A SUBSYSTEM IDENTIFIER ASSIGNED BY THE TEST AGENCY PRIOR TO THE TEST. EXAMPLE: ENGINE ASSIGNED SUBSYSTEM IDENTIFIER "A," TRANSMISSION ASSIGNED SUBSYSTEM IDENTIFIER "B," ETC.
- 4 **MAINTENANCE CATEGORY, PRESCRIBED.** THE MAINTENANCE CATEGORY PRESCRIBED BY THE MAINTENANCE ALLOCATION CHART IS INDICATED USING THE FOLLOWING CODE: C - OPERATOR/CREW; O - ORGANIZATIONAL; F - DIRECT SUPPORT; H - GENERAL SUPPORT; D - DEPOT.  
  
**MAINTENANCE CATEGORY, RECOMMENDED.** USE THE CODE LETTERS, C, O, F, H, OR D TO INDICATE THE MAINTENANCE CATEGORY RECOMMENDED BY THE TEST AGENCY.  
  
**MAINTENANCE CATEGORY, ACTUAL.** THE ACTUAL MAINTENANCE LEVEL AT WHICH THIS TASK WAS PERFORMED AT THE TEST AGENCY.
- 5 **TM INSTRUCTIONS, ADEQUATE.** AN X IN THIS COLUMN INDICATES THE TM INSTRUCTIONS COVERING THIS MAINTENANCE TASK OR ACTION ARE ADEQUATE.  
  
**TM INSTRUCTIONS, INADEQUATE.** WHEN THE TM INSTRUCTIONS ARE CONSIDERED INADEQUATE, INSERT THE TEST AGENCY EPR NUMBER (IF APPROPRIATE) WHICH TRANSMITTED THE DA FORM 2028.

EPG FORM 1313A (REV)  
3 AUG 1974

SUPERSEDES EPG FORM 1313A, DTD 15 JUL 1973  
WHICH IS OBSOLETE.

**COLUMN**

- 6**     **ACTIVE MAINTENANCE TIME.** MANHOURS AND CLOCK HOURS REQUIRED FOR THE MAINTENANCE OPERATION TO THE NEAREST TENTH OF AN HOUR. ELAPSED HOURS ARE THE TOTAL HOURS THAT THE MAINTENANCE ACTION REQUIRED INCLUDING ALL DELAYS. IF THE OPERATION WAS NOT ACTUALLY PERFORMED BUT WAS REVIEWED, THE ESTIMATED ACTIVE MAINTENANCE TIME IS INDICATED BY USING THE PREFIX E. (UNUSUAL DIFFERENCES IN MAINTENANCE TIMES FOR THE SAME OPERATION SHOULD BE EXPLAINED IN THE BODY OF THE TEST REPORT.)
- 7**     **SYSTEM LIFE.** THE NUMBER OF OPERATIONAL HOURS (ESSENTIAL) AND MILES, ROUNDS, EVENTS, ETC., AS REQUIRED IN THE TEST PLAN, ACCUMULATED DURING THE TEST BEFORE MALFUNCTION OR SCHEDULED SERVICE OCCURRED. (UNDER THE LIFE FIGURE, ENTER IN PARENTHESES THE SEQUENCE NUMBER FOR WHICH THAT PARTICULAR OPERATION WAS LAST PERFORMED FOLLOWED BY THE APPROPRIATE LIFE UNIT; I.E., M, H, R, ETC.). "S" WILL BE PLACED IN THIS COLUMN IF THE OPERATION WAS PERFORMED ON A SAMPLING BASIS AND NOT BECAUSE OF AN ACTUAL MAINTENANCE ACTION.
- 8**     **DIAGNOSTIC TIME.** THE PORTION OF MAINTENANCE TIME CLOCK HOURS WHICH WERE USED TO DIAGNOSE THE MALFUNCTION.
- 9**     **REASON PERFORMED.** THE SYMBOL "UNSCHED" WILL BE ENTERED IN THIS COLUMN IF THIS OPERATION WAS PERFORMED AS A RESULT OF UNSCHEDULED MAINTENANCE. IF THE OPERATION WAS PERFORMED AND RECORDED AS A REQUIRED PORTION OF A SCHEDULED MAINTENANCE SERVICE, THE SYMBOL "SCHED" WILL BE USED. IF THE OPERATION WAS PERFORMED ONLY TO VERIFY PROCEDURES OR TOOL REQUIREMENTS, NOT TO CORRECT A MALFUNCTION, THE SYMBOL "SIM" WILL BE ENTERED.
- NOTE.**     **SEPARATE MAINTENANCE ANALYSIS CHARTS WILL BE USED TO RECORD SIMULATED MAINTENANCE ACTIONS.**
- 10**     **REMARKS.** WHEN AN EPR IS RELATED TO A MAINTENANCE OPERATION, THE EPR NUMBER IS ENTERED. THE REMARKS COLUMN WILL BE USED TO IDENTIFY MAINTENANCE FUNCTIONS WHICH ARE CONSIDERED FAILURES FOR RELIABILITY COMPUTATIONS. THE TIME IN MANHOURS PRESCRIBED BY THE MAC TO PERFORM EACH FUNCTION WILL ALSO BE ENTERED HERE OR LOCALLY DEVISED FORMS MAY REQUIRE ENTRY OF THE INFORMATION IN A SEPARATE COLUMN. CSF DENOTES CHARGEABLE SYSTEM FAILURE.

**EPG FORM 1313A (REV)**  
**3 AUG 1974**

**SUPERSEDES EPG FORM 1313A, DTD 13 JUL 1973**  
**WHICH IS OBSOLETE.**

# MAINTENANCE ANALYSIS CHART

PROJECT NO.  
P-EE-TRC-1117-005

NUMERICAL  
RADIO TERMINAL SET AN/TRC-1117/151

IDENTIFICATION NO.  
0044

PAGE  
1

GP. NO. COMPONENT AND (SEQ. RELATED OPERATIONS NO)	MAINTENANCE LEVEL U C-OPERATOR/CREW B D-ORGANIZATION F-DIRECT I M-GENERAL D D-DEPUT PRE REC ACT	INSTRUCTIONS ADOT INADOT 5	CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE	DIAG TIME	REASON PERFORMED	REMARKS
1 2	3 4	5	6	7	8	9	10		
0000 INITIAL INVENTORY AN I 1 A) D INSPECTION	D O O O	X	3.0	6.0	3.0	0.0 -H	0.0	SCHED	
0000 OPERATIONAL TEST AS ( 1 B) LISTED IN DEPTM 11-5 895-366-14-1 PAGE 3- 1	O O O O	2028	2.1	2.1	2.1	0.0 -H	0.0	SCHED	
0006 ALIGNED 2EA MULTIPLE ( 1 C) XER TO-352 IAW 11-58 05-367-35/3	F F F F	X	1.0	2.0	1.0	0.0 -H	0.0	UNSCHED	THE TO-352'S WERE TESTED WI THIN THE MAC TIME LIMIT. MAC TIME FOR THE TO-352 IS .5 HOURS EACH. INITIAL INVENTO RY.
0000 PERFORMED ORGANIZATI ( 1 O) ONAL PMCS IAW DEPTM 11-5895-366-14-1 PAG E 5-4	O O O O	X	3.2	3.2	0.0	0.0 -H	0.0	SCHED	NO TIMES GIVEN IN MANUAL
0000 REPLACED PANEL SA3 I ( 2 ) AN IN 11-5805-367-12 TD-202	O O O O	X	0.2	0.2	0.2	25.00-H	0.1	UNSCHED	NO MAC TIME GIVEN IN TM. P ANEL SA3 IN TD-202 HAD NO R ECEIVE.
0000 REPLACED TO 1065 IAW ( 3 A) DEPTM 11-5895-366-14 -1 PAGE 5-101 PARA 5 -14A AND 5-14B	MP O O O	X	0.5E	0.5E	0.5	686.00-H	0.0	SIN	NO LISTING IN MAC FOR TO 10 65.
0000 REPLACED TO 1069 IAW ( 3 B) DEPTM 11-5895-366-14 -1 PAGE 5-101 PARA 5 -14A AND 5-14B	MP O O O	X	0.3E	0.3E	0.3	686.00-H	0.0	SIN	NO LISTING FOR TO-1069 IN M AC
0002 REPLACED THE 19A6 CA ( 3 C) RD IN THE TO 1065 SM 26 IAW OTM 11-5805-6 37-12	O O O O	X	0.2E	0.2E	0.2	686.00-H	0.0	SIN	THIS WAS SIMULATED MAINTENA NCE IN THE TRC-1117

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL		INSTRUCTIONS	ACTIVE MAINTENANCE TIME		SYSTEM LIFE		REMARKS
		S	B		CLOCK HOURS	MAN HOURS	H-HOURS	M-MILES R-ROUNDS	
		D	F-DIRECT						
		PRE REC ACT		ADDT INADDT					
1	2	3	4	5	6	7	8	9	10
0103	REPLACED THE PORT CH	0	0	X	0.2E NC	0.2E NC	0.0	SH	THIS WAS SIMULATED MAINTENANCE IN THE TRC-117
(3 U)	ANUEL CARD IN THE TO								
	1049 SN 7 1AW DTM 11								
	-5805-438-12								

GP. NO. COMPONENT AND (SEQ. RELATED OPERATIONS NO)	1	2	3	4	5	6	7	8	9	10
0000 INITIAL INVENTORY AM ( 1 A) 0 INSPECTION	0	0	0	0	X	5.0	5.0	5.0	0.0	-H
0000 OPERATIONAL TEST AS ( 1 B) LISTED IN DEPTN 11-5 895-453-14-1 PAGE 3- 6	0	0	0	0	2028	2.0	2.0	2.0	0.0	-H
0000 PERFORMED ORGANIZATI ( 1 C) FINAL PHCS IN ACCORDA NCE WITH DEPTN 11-58 95-453-14-1 PAGE 5-4	0	0	0	0	X	4.2	4.2	0.0	0.0	-H
0000 REPLACED TD-1065 IAW ( 2 A) DEPTN-1105895-453-14 -1 PAGE 5-102 PARA 5 -110	NP	0	0	0	X	0.5E	0.5E	0.5	0.0	-H
0000 REPLACED TD-1069 ( 2 B) IAW DEPTN 11-5895-45 3-14-1 PAGE 5-102 PA RA 5-11A	NP	0	0	0	X	0.3E	0.3E	0.3	0.0	-H

Instructions for  
Tools and Test, Measurement, and Diagnostic Equipment (TMDE) Chart

COLUMN

- 1 Nomenclature or Description. Enter the nomenclature as shown in the manual or if none, enter noun nomenclature and brief description of item. (Enter in parentheses the number of like items received, such "(2 ea)".)
- 2 Federal Stock Number or Part Number. Enter one of the following: Federal Stock Number, Part Number, or Drawing Number in this order.
- 3 Maintenance Category, Prescribed. Maintenance category authorized the item as prescribed by the technical publication.
- 4 Maintenance Category, Recommended. Indicate the maintenance category to be authorized the item as recommended by test agency. If the item is not required, enter none.
- 5 Date Received. Enter the date the tool or item of TMDE was received (Example 6/69). Enter "not rec" if the tool or test equipment was not received.
- 6 Evaluation, Adequate. Enter an X if the item was found to be adequate for use by the mechanics and for its intended purpose at the maintenance category recommended in Column 4. Make no comment on items marked "None" in Column 4.
- 7 Evaluation, Inadequate. Enter an X if the tool was found to be inadequate for its intended use. Make no comment on tools marked "None" in Column 4.
- 8 Required (RQD) Yes or No. A "Yes" in this column indicates the special tool or test equipment is required at the maintenance level indicated in Column 4. A "No" in this column indicates the special tool or test equipment is not required. This column should be marked "No" when "None" is marked in Column 4.
- 9 Listed in Technical Manual. Enter the number of the technical publication for the test item in which the tool or test equipment is listed.
- 10 Remarks. If an EPR is related to the item, the EPR number will be entered. If the item was used only to verify the need for the item, this will be indicated. When it has been determined that an item is not required, indicate the standard item which will perform the required maintenance function if appropriate.

TOOLS AND TIME CHART		PROJECT NO 6-EE-TRC-117-005		NOMENCLATURE Radio Terminal Sets AN/TRC-117/151 and AN/TRC-145							
NOMENCLATURE OR DESCRIPTION	FSN OR PART NO	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORG F-DIRECT H-GENERAL D-DEPOT				DATE RECEIVED	EVALUATION		RQR YES OR NO	TECHNICAL MANUAL IN WHICH LISTED	REMARKS
		PRESB	3	REC'D	4		ADQT	INADQT			
1	2	3	4	5	6	7	8	9	10		
Multimeter AN/USM-223	6625-00-999-7465	O thru D						DEP TM 11-5895-366-14-1 DEP TM 11-5895-453-14-1	Not available.		
Tool Kit Electronic Equip TK-101/G	5180-00-064-5178	O-D	O-D		x		Yes	Same as above			
Multimeter TS 352/U	6625-00-581-2036	F-D	F-D		x		Yes	Same as above			
Tool Kit, Electronic Equip TK 100/G	5180-00-605-0079	F-D	F-D		x		Yes	Same as above			
Tool Kit, Electronic Equip TK 105/G	5180-00-610-8177	F-D	F-D		x		Yes	Same as above			
Tool Kit, Automotive Mech	5180-00-754-0641	F-D	F-D		x		Yes	Same as above			
Tool Kit, Electronic Equip TK 144/G	5180-00-973-4369	H&D					Yes	Same as above	Not available		
Ohmmeter, 212 21A/U	6625-00-246-5880	H&D						Same as above	Not available		

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## Instructions for Maintenance Package Literature Chart

### COLUMN

- 1 Number. Enter Army or manufacturer's publication or draft manual number.
- 2 Quantity. Number of copies received. Insert "0" if none were supplied. Use Chapter 9, AR 310-3, as a guide to determine those publications that should accompany the test item. Publications contained in the maintenance test package should cover operations and functions through general support maintenance and should specify the categories involved.
- 3 Title. Complete title.
- 4 Date Received, Literature. Enter date publication was received.
- 5 Date Received, Materiel. Enter date test item or materiel was received.
- 6 & 7 Evaluation. Insert "X" in appropriate block. Minor errors noted on DA Form 2028 are not in themselves sufficient reasons to term a publication inadequate.
- 8 Form 2028. Insert EPR number (if appropriate) and date DA Form 2028 was forwarded.
- 9 Remarks. In addition to appropriate remarks, explain if manuscript was not evaluated and the reason therefor.

MAINTENANCE PACKAGE LITERATURE CHART		PROJECT NO 6-EE-TRC-117-005		NOMENCLATURE AN/TRC-117 and AN/TRC-145 - Radio Terminal Sets						
MANUSCRIPT				DATE RECEIVED			EVALUATION		FORM 2028	REMARKS
NUMBER	QTY	TITLE	LIT	MATERIEL	ADQT	INADQT	DATE FORWARDED			
1	2	3	4	5	6	7	8	9		
DEP TM 11-5895-366-14-1	2	Operator, organizational DS, GS maint man for Radio Terminal Set AN/TRC-117( )XC 1975				x		Incomplete		
DEP TM 11-5895-453-14-1	2	Operator, Organizational DS, GS maint man for Radio Terminal Set AN/TRC-145( )XC 1975.						Incomplete		

## PARTS ANALYSIS CHART INSTRUCTION SHEET

GENERAL. THE PARTS ANALYSIS CHART PROVIDES FOR A LISTING OF THE PARTS USED IN MAINTAINING THE TEST ITEM. PARTS WILL BE GROUPED ON THIS CHART BY FUNCTIONAL GROUP AND IN FEDERAL STOCK NUMBER (FSN) NUMERICAL ORDER WITHIN EACH GROUP.

COLUMN	DESCRIPTION
1	GROUP AND SEQUENCE NUMBER. PARTS USAGE BY MAINTENANCE OPERATION IS INDICATED BY A CROSS REFERENCE TO THE GROUP NUMBER AND SEQUENCE NUMBER FROM COLUMN 1 OF THE MAINTENANCE ANALYSIS CHART.
2	FEDERAL STOCK NUMBER. RECORD THE FEDERAL STOCK NUMBER, TECHNICAL SERVICE PART NUMBER, MANUFACTURERS PART NUMBER, OR DRAWING NUMBER IN THIS ORDER OR PREFERENCE.
3	NOUN NOMENCLATURE. AS LISTED IN THE PARTS MANUAL.
4	MAINTENANCE LEVEL, PRESCRIBED. THE MAINTENANCE LEVEL PRESCRIBED BY THE PARTS LIST UNDER REVIEW. USE THE CODE C - OPERATOR/CREW, O - ORGANIZATIONAL, F - DIRECT SUPPORT, H - GENERAL SUPPORT.
5	MAINTENANCE LEVEL, RECOMMENDED. THE CODE SYMBOLS C, O, F, OR H INDICATE THE MAINTENANCE LEVEL RECOMMENDED BY THE TEST AGENCY.
6	PART LIFE. THE NUMBER OF OPERATING HOURS (ESSENTIAL) AND MILES, ROUNDS, EVENTS, ETC., AS REQUIRED BY THE TEST PLAN, ACCUMULATED BY THIS PART. THIS IS ACTUAL PART LIFE AND SHOULD AGREE WITH THE PART LIFE REPORTED ON THE EPR. EACH ENTRY IN THIS COLUMN IS FOLLOWED BY THE APPROPRIATE LIFE UNIT SYMBOL (H, M, OR R).
7	REASON USED. THE SYMBOL UNSCHED WILL BE ENTERED IN THIS COLUMN IF THIS PART WAS USED AS A RESULT OF UNSCHEDULED MAINTENANCE. IF THE PART WAS REPLACED AS A REQUIRED ACTION OF SCHEDULED MAINTENANCE, THE SYMBOL SCHED WILL BE ENTERED. IF THE PART WAS USED AS A TIME CHANGE COMPONENT, TCC WILL BE ENTERED. IF THE PART WAS CONSUMED TO VERIFY PROCEDURES OR TOOLS, NOT TO CORRECT A MALFUNCTION, THE SYMBOL SIM WILL BE ENTERED.
8	REMARKS. IF AN EPR IS RELATED TO THE PART USED, THE EPR NUMBER WILL BE INSERTED IN THIS COLUMN. WHEN THE PART WAS REPLACED TO CORRECT A FAILURE, IT WILL BE INDICATED BY INSERTING THE WORD FAILURE IN THIS COLUMN.

EPG Form 1316 A (Rev)  
15 Jul 1973

Supersedes EEP Form 1316 A, 1 Oct 70,  
which is obsolete

IDENTIFICATION NO. PAGE  
0044 1

PROJECT NO. Nomenclature  
6-EE-TRC-117-005 RADIO TERMINAL SET AN/TRC-117/151

PARTS ANALYSIS CHART

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE		REASON USED	REMARKS
			LEVEL	PART LIFE		
			C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPT	H-HOURS H-HOURS R-ROUNDS		
1	2	3	PRESB RECH 4 5	6	7	8
0000	5805-00-945-1186	PANEL 5A3 (TD-202)	(1)	(1)	UNSCHE	REPLACED FROM RUNNING SP ARES.
( 2 )	( 1EA )					

APPENDIX E. SOLDIER-OPERATOR/MAINTAINER COMMENTS

Comments of the soldier-operator/maintainer were as follows:

1. Soldier-operator/maintainer No. 1.

a. Vent covers on doors and covers on distribution panels won't stay open in windy areas.

b. Vent covers on air vent doors open too wide. Hazard with bumping head at night.

2. Soldier-operator/maintainer No. 2.

The front vent doors on these vans do not hook properly. If a strong breeze comes along they slam shut.

3. Soldier-operator/maintainer No. 3.

Power box should be lower, door vent, when raised and door is opened fully, vent door is in the way.

4. Soldier-operator/maintainer No. 4.

Should have brace on the inside air vent door (like on 61 van) to stop the wind from catching door then slamming closed.

5. Operator/maintainer No. 5.

The TD-660, TD-1069, and the TD-1065's cable routing should be improved. As it is now, the complete units have to be removed from the mounting racks just to change a cable including the AC plug. This only adds to the downtime of the system and it takes an excessive waste of man-hours just to change a simple cable.

6. Soldier-operator/maintainer No. 6.

In the TRC-117 after the parabolic antennae is taken out of the rig there is a big mounting stud sticking out of the floor. There should be some kind of mount used that doesn't leave this, so more effective use of space could be accomplished.

7. Soldier-operator/maintainer No. 7.

There are lifting requirements labeled on only the Band IV tuning head of the AN/GRC-103 radio. When the Band IV tuning head is removed and another separate band tuning head is replaced, the lifting requirement label is removed. The label on the Band IV tuning head provides confusing information as a two man lift is not feasible with the small handle on the Band IV and the item does not need two men for lifting. There should be some way of indicating a lift requirement when the total component (transmitter or receiver) is removed.

APPENDIX F. REFERENCES

1. Letter, AMSTE-EL, TECOM, subject: Test Directive for Product Improvement Test of the Telephone Terminal Set AN/TRC-117/151, TECOM Project No. 6-EE-TRC-117-005, dated 25 January 1973.
2. Department of the Army Proposed Materiel Need (Engineering Development) (PMN (ED)) for Time Division Digital Multiplexer (TDDM) (TD-1069), 5 July 1972.
3. Department of the Army Approved Materiel Need (Engineering Development) (MN(ED)) for High Speed Serial Data Buffer (HSSDB) (TD-1065) (CDOG para 839g (12), 17 August 1972.
4. EL-CP0131-0001A, High Speed Serial Data Buffer TD-1065( )/G, 7 February 1972 w/Amendment No. 4, 21 February 1973.
5. MIL-S-49038(EL), Shelter, Electrical Equipment S-541( )/TTC-38(V), 27 December 1974.
6. MIL-S-35557A(EL), Shelter, Electrical Equipment S-330( ), TRC-117(V), 4 December 1970.
7. MIL-STD-252B, Wired Equipment, Classification of Visual and Mechanical Defects for, Change 1, 19 January 1970.
8. MIL-STD-415B, Test Points and Test Facilities for Electronic Systems and Associated Equipment, Design Standard for, 8 February 1961.
9. MIL-STD-454C, Standard General Requirements for Electronic Equipment, 15 October 1970.
10. MIL-STD-882, System Safety Program for Systems and Associated Subsystems and Equipment: Requirements for, 15 July 1969.
11. MIL-STD-1472B, Human Engineering Design Criteria for Military Systems, Equipment and Facilities, 31 December 1974.
12. MIL-STD-1474(MI), Noise Limits for Army Materiel, 1 March 1973.
13. SCL-1280D, Design of Electronic Equipment for: and System Installations in Shelters and Vans, 15 March 1965.
14. TECOM Supplement 1 to AR 750-1, Maintenance of Supplies and Equipment, Army Materiel Maintenance Concepts and Policies, 25 March 1974.
15. AR 702-3, Army Materiel Reliability, Availability, and Maintainability (RAM), 22 March 1973.

16. MIL-STD-188-100, Military Standard, Common Long Haul and Tactical Communication System Technical Standards, 15 November 1972.
17. MIL-S-55590C(EL), Shelter Electrical Equipment S-390A( )TRC-145, 10 December 1970 w/Amendment 1, 22 February 1973.
18. EL-CP0138-0001A, Time Division Digital Multiplexer, TD-1069( )/G, 4 May 1972 w/Amendment 4, 6 July 1973.
19. Letter, AMSTE-EL, TECOM, subject: PIP Tests; Radio Terminal AN/TRC-145, TECOM Project No. 6-EE-TRC-145-003, and Telephone Terminal AN/TCC-65, TECOM Project No. 6-EE-TCC-065-009 dated 8 August 1975.

#### APPENDIX G. ABBREVIATIONS

BCI	bit count integrity
BER	bit error rate
HFE	human factors engineering
HSSDB	High Speed Serial Data Buffer
MN	Materiel Need
MTBF	mean-time-between-failures
PCM	pulse code modulation
PI	product improvement
SOMTE	soldier-operator/maintainer test evaluation
TDDM	Time Division Digital Multiplexer
TMDE	test, measurement, and diagnostic equipment

APPENDIX H. DISTRIBUTION LIST

\*No. of draft copies to be sent to TECOM for approval prior to final distribution.

	<u>Test Plan</u>	<u>Final Report</u>
Commander	9*	12*
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DRSTE-SG-H		1
Aberdeen Proving Ground, Maryland 21005		
Commander		
USA Materiel Development & Readiness Command		
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DRCRD-U	1	1
DRCRD-R	1	1
DRCMA	1	1
DRCQA-P	1	1
DRCSE-E	1	1
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USA Electronics Command		
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Army Tactical Communications Systems	5	5
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Commander		
USA Training & Doctrine Command		
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US Marine Corps LnO USA Test & Evaluation Command Aberdeen Proving Ground, Maryland 21005	1	1

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TRI-TAC/TT-O	1	1
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